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CONTENTS.

EDITORIAL:
American Electrochemical Society . . . 573
Phase Displacement in Alternating-Current Electrolysis . . . 573
A Successful Use of Electric Rock Drills . . . 575
The American Street and Interurban Railway Association . . . 575
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw . . . 576
Subway System for Chicago . . . 578
Decision in Storage-Battery Litigation . . . 578
Manhattan Transit Company Sold . . . 578
San Francisco's Progress Toward Recovery . . . 578
Electric Railway Engineering Preliminaries—Part II, by Sydney W. Ashe . . . 579
American Electrochemical Society . . . 583
How Electricity Was Served to Consumers and Street Car Lines by the San Francisco Gas and Electric Company After the Fire, by L. E. Reynolds . . . 584
Two Cities Left in Darkness by Breaking of a Canal Bank . . . 586
General Electric Company to Issue New Stock . . . 586
The Street Railway Convention . . . 587
Tramway Lines on the Continent, by C. L. Durand . . . 589
Frequency Meters, by F. Conrad . . . 594
The Effect of Iron in Distorting Alternating-Current Wave-Form (Concluded), by Frederick Bedell and Elbert B. Tuttle . . . 595
Dedication of the New Building for the Engineering Departments of the University of Pennsylvania . . . 597
Traction Managers' and Auditors' Association . . . 597
The Testing of Coal, by A. Bement . . . 597
Double Trolley System Not a Sure Cure for Electrolysis . . . 600
The Maximum Development of the Steam Engine . . . 600
Electrical Notes from Great Britain . . . 601
Instructing Telephone Operators . . . 602
Single-Phase Equipment for the Washington, Baltimore & Annapolis Railway . . . 602
The New Plant of the Home Telephone Company, Detroit, Mich . . . 603
Evening Courses in Direct-Current Testing at the Polytechnic Institute, Brooklyn . . . 603
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 604
METHODS OF GETTING NEW BUSINESS . . . 606
INDUSTRIAL SECTION:
A Metallic Support for Cross-Arms . . . 607
The Marshall Electric Manufacturing Company's Standard Dial Switch . . . 608
A Fifty-Ampere Dry Cell . . . 608
The Franklin Electric Manufacturing Company's Street Railway Incandescent Lamp . . . 608
Small Generators Arranged for Direct Connection . . . 608
National Motor-Generators in the Substations of the Columbus, Ohio, Railway and Light Company . . . 609
Electric Power in the Plant of the Springfield Metallic Casket Company, of Springfield, Ohio . . . 609
Diesel Oil Engine Test . . . 610
The New Plant of the H. T. Paiste Company . . . 610
Portable Car Telephones . . . 611
Linemen's Portable Telephone-Testing Sets . . . 611
A New Lamp Guard . . . 612
Cook's Automatic Electrical Testing and Resetting Plug . . . 612
CURRENT ELECTRICAL NEWS . . . 613
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES . . . 618
RECORD OF ELECTRICAL PATENTS . . . 619

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THE AMERICAN ELECTROCHEMICAL SOCIETY.

The American Electrochemical Society held, during the present week, a short meeting in New York city. Heretofore semi-annual meetings have been held, but a large number of the members have been in favor of but one meeting, and the present plan has been adopted as a sort of compromise. As an experiment this can hardly be called a success, for the attendance was slight and the interest shown in the papers small. For some reason or other the interest in this society seems to be on the wane. The attendance at the meetings grows smaller, and except for the work of a few members, the papers presented have become less interesting to the greater number. Whatever may be the reason for this, the trouble should be found and remedied.

The society started out a few years ago with a broad field before it, and apparently with unbounded enthusiasm; to-day it can not draw twoscore people to one of its meetings, even when held in New York city, and to those who intend attending it can not give definite information regarding the plans of the meeting and the papers to be read a week in advance. Conditions can not go on as they are at present. If the society wishes to carry out the purpose for which it was organized it would seem about time to bring about a general stirring-up. Nobody can be expected to attend meetings unless papers of general interest can be looked for; and no one with the material for a good paper will care to read it before the society if he can not at least be sure of an interested audience.

PHASE DISPLACEMENT IN ALTERNATING-CURRENT ELECTROLYSIS.

When an alternating current is passed through an electrolytic cell, several phenomena appear. The actual result accomplished will depend upon several factors. If the construction of the cell be such that a direct current may cause electrolysis, a similar reaction will undoubtedly take place, due to the alternating current; but since this is periodically reversed, the action occurring at the two electrodes will also be reversed, and, neglecting other influences, there will be no resultant decomposition, for whatever of one electrode is dissolved during one half wave will be redeposited upon the electrode during the next half. This is undoubtedly mainly what takes place under the conditions generally met, but if an exceedingly low frequency were employed there might be sufficient time for the compound formed by the current to diffuse throughout the solution, and not all the metal dissolved at one instant would immediately be replated. The result would be that the electrolyte would itself suffer decomposition to make good the deficiency due to the diffusion, and the electrodes would become corroded.

A similar result might be accomplished if a sufficiently violent circulation of the electrolyte were caused to take place at the surface of the electrodes. Under normal conditions, however, but little or no corrosion takes place, provided, of course, there be no purely chemical action. But, under some conditions, disintegration may be brought about, which appears to be partly a mechanical action. This is noticeable principally in using carbon electrodes, and is due either to the effect of gases set free within the pores of the electrode or to a dissolving away of the binding material. Probably both actions occur.

But although no resultant dissolving away of the electrodes may take place in an electrolytic cell, the electrolytic action does occur during every half wave, and this, of course, gives rise to those phenomena noticed in direct-current electrolysis. These, for convenience, may be grouped together under the term "polarization," a term which has been so useful and so much discussed in the study of electrolysis. For the present purpose it is sufficient to consider this polarization as setting up a counter-electromotive force opposing the flow of current which gives rise to it. In addition, there are the electromotive forces due to each electrode, but these under normal conditions are equal and opposite.

Another action, or, better, a rather different action, in alternating-current electrolysis is noticed when the products of the reaction are not soluble in the electrolyte. A notable instance of this kind is that met with when using aluminum as an electrode. The current may pass freely from the solution into the aluminum, but a passage in the opposite direction causes an oxidation of the electrode which acts as an insulating coating and in this way opposes the flow of current. This effect is entirely different from the one mentioned above, although the results of the two are, in a way, similar. It is this insulating effect that has been made use of in the so-called electrolytic rectifiers and electrolytic condensers. In the latter case both electrodes are made of aluminum and both become coated with the insulating layer. No new phenomena are involved in this device, and it may be considered as a leaky or somewhat defective condenser of large capacity—defective because the insulating coating is liable to break down, necessitating reforming, though imperfections of this kind do not destroy the condenser, as would be the case with an ordinary electrostatic condenser. They have large capacity because of the extremely thin dielectric. They have the disadvantage that a loss of energy takes place, heating the device. The arrangement is nevertheless a true condenser and causes a displacement of current in advance of the applied electromotive force.

But a similar displacement of current may be caused by a true electrolytic cell—that is to say, a cell in which electrolytic action takes place normally, due to direct current. The polarization which takes place during one half cycle opposes the flow of current, and it will reverse this current as soon as the voltage of the applied electromotive force is less than that of polarization. If, then, the applied electromotive force be but slightly greater than that of polarization, the current will be reversed almost immediately after the electromotive force has reached its maximum value, and, as a consequence, there will be a phase displacement of current nearly ninety degrees in advance of the applied electromotive force. This is the result obtained with a true condenser, though in one case the opposing electromotive force is due to a chemical change, and in the other case to an electrical charge. Practically, the former has no value for constructing a condenser, since the capacity would be relatively small and the efficiency would be low. Heating will take place due to the passage of the current through the electrolyte, and in some cases due also to chemical action which would be set up as a secondary result of the electrolytic decomposition caused by the current.

But although this effect is not of value for constructing condensers it may become a disadvantage. Probably the most usual method of constructing a non-inductive resistance of large current-carrying capacity is to make use of an electrolytic cell, it being assumed that there is no inductance or capacity in such a device. But, as has been shown, there is a capacity action in such arrangements which, under certain conditions, would vitiate the test. The importance of this factor depends upon the relative values of the electromotive force of polarization and the fall of potential through the cell due to ohmic resistance. Usually the latter is by far the greater; in fact, when testing electrical machinery the condenser effect is not only negligible, but probably could not be detected, so that the assumption that the resistance is non-inductive is justified. This has been demonstrated by recent experiments conducted by Herr Karl Wallin, of the Stockholm Technical High School, who took oscillograph records of the current and electromotive force at the terminals of an electrolytic resistance. These show that the current and pressure were in phase. It should be noted, however, that in these experiments, when the voltage was low, the current was also small, so that polarization was necessarily slight; and that when large currents were employed the voltages were also high, so that the fall of potential due to ohmic resistance made up practically the whole difference of potential between the electrodes. If, however, a high resistance had been obtained by connecting a number of such cells in series, so as to build up a high counter-electromotive force, phase displacement would undoubtedly have been found; in fact, when such effects are sought there is no difficulty in observing them. Oscillograph curves have been published from time to time, showing large phase differences between the currents and applied voltages of electrolytic cells.

Although, in engineering work, the effect of this counter-electromotive force may be neglected, it is possible that in other fields it may cause trouble. It is customary to measure the resistance of solutions by means of alternating currents, and in such cases, unless precautions be taken, Ohm's law can not be applied directly to the readings of current and voltage. If the ohmic resistance be small, or the polarization great, such an assumption might give rise to considerable error.

A SUCCESSFUL USE OF ELECTRIC ROCK DRILLS.

In the issue of the ELECTRICAL REVIEW for September 1 attention was called to an article which discussed rather briefly the relative merits of the electric and compressed-air rock drill, the conclusion being reached that the former type has not been at all successful, due to a lack of ruggedness, which is the saving virtue of the compressed-air drill, as the latter type of drill has little else to be said in its favor. As these conclusions were reached after what seemed to be a rather limited experience with the electric drills, the opinion was expressed that it was hardly fair to the latter to condemn them altogether. Situations, no doubt, exist in which the advantages of the less rugged electric drill are greater than its disadvantages. It was pointed out that there are several types of electric drill, one type being mentioned in which the efficiency of the electric system is combined with the ruggedness of the compressed-air mechanism.

The issue of the *Engineering and Mining Journal* for September 22 contains a reply to the previous article appearing in that journal. In this reply Mr. Charles A. Chase gives, somewhat in detail, his experiences with several electric drills of the combination type. The results obtained with these as compared with those of air drills at the same point were decidedly in favor of the former.

The company with which Mr. Chase is associated had had some unfavorable experience with the simple electric drills, and had discarded them, replacing them with compressed-air drills supplied from a motor-driven air-compressor. In 1904 several compressed-air-electric drills were installed, and, after very thorough tests, were adopted. It was found that, working in competition with the simple compressed-air drills, the former worked considerably faster, and after two years of service they are still in excellent condition. The electric machine drilled from fifty to sixty feet of hole in eight to nine hours, leaving time for the holes to be loaded and shot; while the air drills were merely capable of drilling the same length of hole in the same time. But the advantage of the electric drill which is most marked is its great power economy as compared with the other. This is the strong feature of this type of machine, and in the case here under consideration, the difference is very marked. It was found that the power consumption for one electric drill was only five horse-power, while the motor input at the compressor of the air drill was fifty horse-power; and, as the company purchases its power, the saving effected by the use of the electric drill is a very considerable item. Mr. Chase states that he is not an advocate either of electric power or air power, since each has its advantages; but, to his mind, there is a place for electric drills in many mines, and his company has certainly found one drill that fits this place.

These conclusions are entirely in accord with the opinions expressed in the ELECTRICAL REVIEW. There can be no doubt that, in some places, the ruggedness of the air drill is a feature of the greatest value; but the low efficiency of this device makes it incumbent upon mining engineers to investigate the merits of more efficient machines and to adopt the latter when this gain more than offsets a greater liability to breakdowns.

THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

The American Street and Interurban Railway Association, which meets in Columbus, Ohio, during the week beginning October 15, has a good deal of important work to do. In addition to the reading and discussion of papers, the work of the association's committees is not less valuable. Certain of the committees which are to report at this meeting have been engaged on matters of interest not only to the members of the association, but to the public and to other industries. This applies particularly to the standardization committees, which are endeavoring to bring about certain standard practices in construction work, such as car-building and track work. These committees have been gathering a large amount of data dealing with the present practice, a considerable part of which, no doubt, will be in shape for consideration. It will remain, however, for the association to take such steps as may seem advisable in completing the work of these committees, and in this it should not lose sight of both sides of the question. Standardization is very desirable, so long as it does not bring about cures which are worse than the ills. It is possible to go too far in these matters. It is very well to have a set of general specifications which will guide builders and engineers and thus prevent what would frequently result in freak construction. On the other hand, it is not wise to attempt to bind down the experienced engineer and to force him to use a method when he knows it will not, in the end, be the best. There seems to be a tendency for a standardization committee to recommend rather rigid rules, as recent experience has shown. After having made an elaborate study of current practice it decides upon what, to it, seems to be best, and wishes this to be adopted; yet, in nearly all cases, the work of such a committee should be suggestive, rather than compulsory, particularly when engineering principles are involved. It should point out what seems to be the plan best suited for average conditions. Upon the other hand, there are certain features in practice involving no elements of particular importance, such as the height of car steps and other minor details, but which, to the public, are frequently of much concern. In such matters definite action can very properly be taken and a standard strongly insisted upon. As part of the work of the association's standardization committees deals with such details, it is to be hoped that the work of these committees will be given careful consideration, and, if possible, some definite action taken.

This convention, which follows a year of working under the new system of organization, will undoubtedly be one of the most successful which the affiliated associations have ever held. Present indications are that the attendance will be large. Reservations on the special trains leaving New York are numerous and the representation of eastern interests will be strong.

The exhibit, this year, promises to be full of interest. Ample space is available for complete demonstrations of apparatus, both large and small. The list of exhibitors is extensive, and as each has a pride of membership in the organization the high standard set at Philadelphia last year well be maintained if not excelled.

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

V—The Sources of Natural Water Supply and the Physical and Chemical Characteristics of the Same.

The water supply is only second in importance to that of fuel for the efficient working of steam boilers, and an adequate supply of pure water is an essential condition of cheap steam-generation.

The dissolved impurities, present in varying amounts in all natural waters, separate as sludge or as a scale inside the boiler, and the greater the amount of these impurities, the more often will cleaning and scaling of the boiler be necessary.

The water intended for use in boilers for steam-raising purposes can not, therefore, be too free from impurity, and the generally held opinion that rain-water or condenser water is too pure is fallacious. The corrosive action observed with rain-water is due, not to its purity, but to the impurities present in the form of dissolved gases. On heating the water these dissolved gases (oxygen and carbon dioxide) escape, and the pitting and corrosion found round the feed-water supply-pipe of boilers fed with rain-water is due to the chemical activity of these gases at the moment of their liberation. The best method of expelling these gases before the water enters the boiler will be dealt with in Article VII.

In addition to the gaseous impurities found in natural water, there are present varying amounts of dissolved salts, and in some cases suspended impurities. The carbonates and sulphates of lime and magnesia are the most common dissolved salts, but chlorides and nitrates are also found in some waters. The waters that are free from suspended impurities and appear the most clear and sparkling to the eye are not as a rule the most suitable for use in steam boilers. Chemical examination is always necessary before we can be certain that it will be safe or advisable to use a particular water for steam-raising purposes, without some preliminary treatment for removal of its impurities.

The source from which the water is drawn has much influence upon the character and amount of its impurity. Below, the general characteristics and composition of rain, river and well waters are given so far as these have any bearing upon the use of such waters for steam-raising purposes.

Rain-Water—This is the purest natural water, for it contains only the impurities taken up by the water during its passage from the clouds to the earth, namely oxygen, carbon dioxide, sulphur dioxide, soot and dust. In country districts rain-water is often entirely free from the three last-named impurities, and contains only comparatively small amounts of oxygen and carbonic acid gas. To obtain an adequate supply of such water for boiler-feed purposes, however, involves the creation of large reservoirs fed by large catchment areas, and in most cases this is not possible for the ordinary works or factory, owing to the capital expenditure involved. Rain-water collected in towns or upon the outskirts of industrial districts is, on the other hand, so contaminated with sulphurous acid, soot, dust and other impurities that filtration and chemical treatment are necessary before such water can be safely used in steam boilers. For this reason rain-water is not often employed for feed-water supply except in those special cases where these two objections lose much of their force and weight. It is quite possible, however, that rain-water might be used much more extensively than at present is the case for steam-raising purposes, and that some thought and ingenuity expended by engineers in arranging catchment areas and storage reservoirs would be well repaid in the greater freedom of the boilers from scale and corrosion due to the purity of the feed-water used. An average rain-water will contain less than two parts of dissolved or suspended matter per 100,000 of water.

Surface and River Waters—Rain-water, after it has traveled any distance over the surface of the ground, either in country or town districts, becomes further contaminated with suspended and dissolved matter, and therefore less suitable for use in boilers without some purification treatment. Here again the appearance of the water may be wholly deceptive, and chemical examination will alone reveal the nature and amount of the impurities present. In mountainous districts the amount of impurity taken up from the soil is small, and the surface water collected in the catchment area of Lake Vyrnwy, in North Wales, or in the catchment area of Thirlmere, in the lake district, for supply of the cities of Liverpool and Manchester, respectively, is remarkably pure and free from dissolved salts. As one comes down to lower levels and approaches the neighborhood of towns, the amount of dissolved and suspended matter in the surface water increases considerably. The following tests of the Liverpool water supply are interesting in this respect:

	Parts per 100,000 of Water.		
Vyrnwy—Total solids in solution	4.46	Hardness..	1.70
Rivington—Total solids in solution	10.36	Hardness..	3.90

Vyrnwy is a mountainous district in North Wales, while Rivington is the old catchment area near Bolton. The influence of the neighborhood of towns upon the purity of the supply is shown by the increase of dissolved matter from 4.46 tc 10.36 parts per 100,000.

When the catchment area is formed bv peaty land a large amount of organic matter finds its way into the water, due to the gradual decay of the plant life which forms the peat. In such cases the surface water will be colored brown, and may contain large amounts of organic acids. Surface waters coming from peat or moor-lands, even when colorless, should therefore always be examined by a competent chemist before use in steam boilers, for these organic acids are not detected by the ordinary reagent, litmus.

Surface waters collected in chalky districts may contain large amounts of lime in solution, either as carbonate or sulphate. In some cases the dissolved impurities present in such surface waters may exceed in amount those found in well waters. The impurities present in surface waters, in fact, vary greatly in different districts, and the geological formation of the surrounding country has much influence upon the nature and amount of the impurities. As a general rule, surface waters collected in country districts are purer than river or well waters; and such waters may often be used in boilers without any preliminary purification.

River water, on the other hand, is usually contaminated with the drainage and refuse of the villages and towns situated along its banks, and the water, except when taken from near the river's source, is more impure than the surface drainage water which flows into it. The dissolved salts may in some exceptional cases be less, but the suspended impurities and organic matter are nearly always greater in amount.

As the river grows in width and volume, the impurities as a rule increase in even greater ratio, and attain a maximum at the point where the river meets the tidal waters of the sea. Here sodium and magnesium chloride are added to the list of dissolved salts present in the water. It is, therefore, dangerous to use water from tidal rivers within five miles of their mouth for steam-raising purposes, without daily sampling and testing for detection

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of these impurities. Chlorides are, in fact, most dangerous salts to have present inside a steam boiler.

Spring and Well Waters—The water that has passed through any considerable thickness of the earth's crust is as a general rule highly charged with dissolved gases and salts. The greater the depth from which the water flows, or is pumped, the larger will be the amount of these impurities. Carbonate of lime with the corresponding salt of magnesia is insoluble in pure water, but the presence of carbonic acid in the water renders these salts soluble. This acid is formed in the water by the carbon dioxide dissolved in its percolation through the upper soil and subsoil of the earth's crust. Sulphate of lime, on the other hand, is slightly soluble in pure water; and 1,000 grammes of water can dissolve 2.72 grammes of calcium-sulphate. Carbonates and sulphates of lime and magnesia exist in large masses in the earth's crust. The nature and amount of the dissolved impurities present in well and spring waters therefore varies in different districts, and water drawn from 300 feet below the surface in some districts will be much purer than water from a similar depth in other districts. Since the percolation through the soil removes all suspended impurities and charges the water with dissolved gases, well and spring waters are generally clear and sparkling. Owing to the amount of gaseous and solid impurities they contain these waters are, however, most unsuitable for boiler-feed purposes and they should never be employed if an alternative supply is available. When the local conditions are such that well or spring water must be used, a treatment by chemicals for removal of the greater portion of the impurities is essential to the economical working of the boiler plant.

All waters, from whatever source, containing over fifteen parts of solid matter per 100,000 should, in fact, be submitted to chemical and mechanical purification treatment; and as far as possible the boiler should be fed with the purest water which can be obtained in this way. The formation of scale inside boilers leads to so many evils and so diminishes the efficiency and life of the boiler that in most cases the capital outlay upon and cost of working a softening plant is a wise expenditure of money, and is repaid by the savings in fuel and repairs.

The salts found in solution in natural waters may, in fact, be divided into two classes—scale-forming and non-scale-forming. To the first-named class belong calcium carbonate, magnesium carbonate, calcium sulphate and magnesium hydrate. To the second class belong the following salts: calcium nitrate; magnesium sulphate, nitrate and chloride; sodium sulphate, nitrate and chloride. The carbonates of lime and magnesia produce what is known as "temporary hardness," since it can be removed by boiling; while the sulphates and hydrates of lime and magnesia produce what is known as "permanent hardness." It is important to note that the accumulation of the non-scale-forming salts in a boiler produces evils nearly as great as those caused by scale. Chlorides decompose at temperatures which may be attained in the boiler and produce free chlorine, a most corrosive gas. The sulphates and nitrates, on the other hand, when present as concentrated

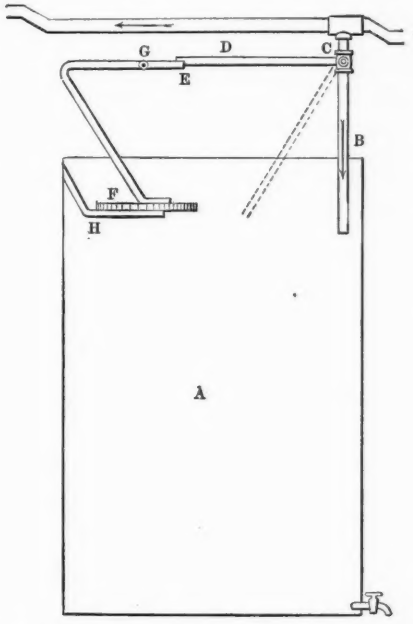


FIG. 22.—ELEVATION OF WATER SAMPLING APPARATUS.

solutions, attack the brass and gun-metal fittings of the boiler, and cause much trouble from leakage. When using feed-water containing considerable amounts of these non-scale-forming salts, it is therefore necessary to blow off the boiler at frequent intervals. This, of course, means loss of heat and diminution of its working efficiency. For these reasons, in nearly every large works, it will be found that economy is promoted by the use of a purer water, or by the erection of a water-softening plant.

SAMPLING BOILER FEED-WATER.

The sampling of water does not present such difficulties as the sampling of fuel, but some thought and care must be expended upon the matter if fair and representative samples are to be obtained.

The water in large tanks or reservoirs can be adequately sampled by stopping the flow of water from the inlet pipe, using a wooden plunger to mix the water, and after waiting ten minutes, withdrawing one or more samples of the water in Winchester quart glass bottles provided with well-fitting glass stoppers. These bottles are rinsed out twice with the water to be sampled, and are then held until filled in a vertical position, with the mouth one inch below the surface of the water in the reservoir or tank. In large reservoirs it is advisable to take samples from more than one position, filling an aliquot portion of the bottle from each selected point, and a boat is requisite in these cases for the work of sampling.

If the supply of natural water is known to be quite constant in character and composition, the sample may be taken either at the inlet or exit pipe of the tank or reservoir; but in most cases it is advisable at the same time to sample the whole body of water as described above, and to compare the test results.

The sampling of water as it flows from the reservoir or tanks to the boilers can also be carried out by automatic apparatus, and below a description is given of an apparatus which is in use at Joseph Crosfield & Sons' Soap Works, Warrington, for this purpose.

Fig. 22 is a sectional elevation of a portion of this sampling apparatus. A is an iron tank, twenty-four inches in diameter by thirty-six inches in height, provided with a runoff tap at the bottom. Above this tank a three-quarter-inch wrought-iron pipe branches from the main supply pipe to the boilers, and delivers the water into the tank A, by the one-half-inch diameter down flow-pipe marked B, and cock C. This cock is opened and closed by the lever D, formed of solid iron rod, and sufficiently heavy to fall into the position shown by the dotted line, when the support at the point E is withdrawn. F is a wooden float, eight inches in diameter and one and one-half inches in thickness, which ordinarily rests on the support H, and by means of an elbow lever and pivoted joint at G, provides a support for the cock lever at E. When the tank is quite filled with water, the float F rises off its support, the lever D is released at E and drops into the position of the dotted lines, thus automatically closing the cock C, and cutting off the supply of water to the tank A.

By arranging that the pressure of water in the three-quarter-inch pipe is not too great, and by providing a series of these

tanks, each with its float and cock, it is possible to collect any number of samples of water, each representing the flow from the softening apparatus, or to the boilers for an equal period of time.

The supply-pipe must be bent as shown in Fig. 22 between each successive tank, in order to make these fill in rotation, and by aid of a cock on the three-quarter-inch pipe where it joins the main to the boilers, the flow of water can be regulated so that each of the tanks requires any predetermined period of time for filling. A series of twelve tanks may thus be made to contain samples of twelve or twenty-four hours' work, and from these twelve tanks either a general sample may be prepared by putting twelve equal portions into a Winchester quart bottle and vigorously shaking; or any particular one may be sampled and tested as desired.

This apparatus is of especial use in checking the work of softening apparatus of the automatic and continuous type, since, for the reasons given in the next article, one can never be certain that the amount of softening chemicals is correct unless regular and systematic sampling and testing are carried out.

The sampling of water from springs and artesian wells demands a different method of sampling, for here it is important that the water should lose none of its dissolved gases before testing. In this case, therefore, the Winchester quart glass bottle is filled directly from the spring or well, with as little delay as possible. Care must be taken also to select a bottle with a particularly close-fitting stopper, which should be tied down after the sample is taken. Samples of well and spring water should not be exposed to sunlight and should not be violently shaken before testing, since either of these influences may influence considerably the amount of gaseous matter retained in solution in the water.

Subway System for Chicago.

It has been announced that the Chicago Union Traction and the Chicago City Railway companies have agreed to do away with down-town surface lines. The initial cost to be paid by the companies is approximately $5,000,000, the Union Traction Company paying $3,000,000, and the City Railway Company $2,000,000. The route of the tunnel has not been fixed, but will be decided by the engineers and representatives of the city.

Decision in Storage-Battery Litigation.

On October 1, 1906, Judge Hazel, sitting in the United States Circuit Court for the Southern District of New York, issued a decision in the suit brought by the Electric Storage Battery Company, Philadelphia, Pa., against the Gould Storage Battery Company, New York city, alleging infringement of the patent to Mailloux, No. 430,868, June 24, 1890, in favor of the Gould company. The alleged infringement was the system regularly employed by the Gould Storage Battery Company, in which a battery booster has its field automatically regulated by a counter machine whose electromotive force is, in turn, regulated by the current fluctuations of the main generator or generators. A Gould installation in the power plant of the Lexington & Boston Street Railway Company, Lexington, Mass., was the particular plant upon which testimony was taken.

The complainant claimed infringement on claims two and six. The Mailloux patent described the regulation of the booster by the fluctuations of the working circuit, and showed the field winding of the booster in the working circuit, so that it would be subjected to all the fluctuations on the trolley line. Judge Hazel held that a prior system described by Lane Fox in an early patent contained the elements of the system, except only the particular location of the regulating coil.

The court held that the regulation of the defendant's counter machine by a field winding in the circuit of the generator involves a different principle, and produces a different kind of regulation and distinct results.

The court sums up as follows: "My conclusion is that the claims can not be given a scope to embrace a booster automatically regulated by a coil in the generator circuit, when such regulation occurs by the conditions of such a circuit. It follows that the defendant's system can not be included in the scope of the claims in suit, and its means of regulation do not correspond to those of the complainant, nor do they produce the same result."

Manhattan Transit Company Sold.

The Manhattan Transit Company has been sold by Joseph H. Hoadley to John C. Sheehan, of New York city. The Manhattan Transit Company has a state franchise under which it has claimed a monopoly of the passenger traffic, other than on street railway cars and the Fifth avenue omnibus line, on the streets of the city of New York. It claims equal rights with the Fifth avenue 'bus line on Fifth avenue, and exclusive rights other than on street railway cars, on all the streets of all the cities of New York state. In addition, the company owns fifty-one per cent of the stock of the New York & Brooklyn Railway Company, which claims a franchise to construct a subway from the Post-office in Manhattan to any point in the borough of Brooklyn.

It is also announced that Mr. Sheehan has secured control of the Long Acre Light and Power Company. This company was organized about a year ago by a number of theatrical men for the purpose of furnishing themselves with electric light. Following the transfer of the company to Mr. Sheehan, William H. Lambrecht, a Cleveland banker, was made chairman of the board.

The Long Acre Light and Power Company claims a franchise permitting it to distribute electricity for lighting purposes. It is announced that the company proposes to enter the electric lighting field at once and to exercise all its rights under its charter.

San Francisco's Progress Toward Recovery.

A bulletin recently issued by the California Promotion Committee gives some remarkable figures indicating the progress of San Francisco, Cal., toward recovery from the effects of the recent fire and earthquake. Reports from all railroads entering California show that traffic has increased enormously, both on colonist and tourist tickets. All parts of California are feeling this infusion of new settlers. Labor supply is still inadequate to meet the demand, both in city and country districts. There is great need of ordinary laborers in San Francisco, and the demand for skilled artisans in building trades is constantly increasing.

Estimates based on computations of military authorities place the present population of San Francisco at 370,000. The enrollment in the school buildings is placed at 29,803. It is estimated that with proper facilities there would be at least 15,000 more school children ready to take up instruction.

Of $208,000,000 insurance on property in San Francisco destroyed by fire, $150,000,000 has been paid policy-holders.

During September there were 1,050 building permits issued, with a value of $5,902,000. There were 316 building contracts recorded, having a value of $3,252,090. The bank clearings were $198,712,503.47. The bank clearings for September, 1905, were $168,329,716.22.

Electric Railway Engineering Preliminaries—Part II.[1]

By Sydney W. Ashe.

HIGH-SPEED Interurban Electric Railways — The primary factor which usually governs the engineering preliminaries of an interurban, intercity electric railway is its ability to compete with steam roads already covering the same territory. The success of such a proposition therefore depends upon offering a frequent, high-speed service.

Using the curves for city traffic, Fig. 5, Part I, to determine the most suitable service for an interurban proposition, would lead to erroneous results. There are two population values to be considered in an interurban proposition, the population of the towns through which the railway passes and the population of the rural districts surrounding the railway under projection. Considering the former population, only about one-third are passengers; whereas with the latter, rural districts, the amount of traffic is very small. As an illustration, statistics secured by the Muncie, Hartford & Fort Wayne Railway Company show that 82.7 per cent of its passenger traffic comes from towns in intercity traffic, whereas but 17.3 per cent of the traffic is supplied by rural districts.

Assuming a high-speed service a necessity, other limiting factors enter into consideration, such as large energy consumption at high speeds for cars of few units. This tends to eliminate single-car operation. In the experiments performed upon the Buffalo and Lockport line of the International Railway Company in March, 1900, the fact was discovered that with trains of one or two units operating at maximum speeds of seventy-five miles per hour, the watt-hour consumption per ton-mile was 137, compared with seventy-five watt-hours per ton-mile for a train of several units.

Another factor must be considered, namely, that the maintenance of high speeds calls for very low grades, a maximum of about three per cent, and for the elimination of sharp curves and in fact all curves where possible. Long curves are not desirable, as a motorman can not see sufficiently far ahead to prevent accidents. If the road is equipped with block signals this difficulty disappears.

DETERMINATION OF MOTOR CAPACITY.

Four methods are in common use for determining the motor capacity required for a given service. These may be designated as

1—The rule-of-thumb method;
2—Armstrong's method;
3—Storer's method;
4—Hutchinson's method.

The Rule-of-Thumb Method — This method consists in having at hand data in tabulated form upon all of the principal railway installations throughout the country. The problem under consideration is compared with this table and from the table is selected an installation of somewhat similar nature. The motor capacity of this installation is then noted and considered with reference to the problem at hand. Care is taken in such cases to select a system in which the profile and contour of the road are somewhat similar to the problem at hand, and also to note that the total weight of the equipment, including passenger load, and the schedule speed compare favorably.

The rule-of-thumb method is based upon the assumption that a motor capacity which has proved adequate in one service will serve equally well in another service which is almost similar. This assumption is justifiable and in fact is followed almost unconsciously by many engineers. The data for such a table may be readily obtained by reference to the technical journals for past years in which descriptions may be found, giving data, upon almost every installation of note. In addition may be found descriptions of new rolling stock, representing improved methods, installed on old systems. Data of this kind may be arranged both alphabetically and according to total horse-power of motor per car installed. Table 1 illustrates in brief form the latter method. Referring to this table, it may be noted that the motor capacity per unit ranges from one single forty-horse-power motor to four 550-horse-power motors, or a total of 2,200 horse-power. The maximum speeds range from about sixteen miles per hour to seventy miles per hour. As case 14 in Table 1 includes locomotive service a truer comparison of horse-power would be with case 13. The number of motor units varies from one to four, depending upon the amount of traction desired. Where the traffic conditions are severe a four-motor equipment is often preferable.

Referring to Table 1 and to the original problem worked out in Part I, in which a car has a length of sixteen feet, a total weight including passengers of 14,860 pounds, and operating at a schedule speed of 8.5 miles per hour, it is obvious that two twenty-five-horse-power motors would be ample. The service, in other words, would correspond to that of Austin, Tex., providing the contour and profile were about the same.

Owing to the lack of available data the foregoing method does not meet with success, when applied to an original problem of widely different nature, such as a trunk-line problem. Applying this method to such a problem would be expensive and would probably result in improper design, as the heating of a motor under these conditions is entirely different from an inter-

TABLE I.

CAR MOTOR EQUIPMENTS USED BY VARIOUS RAILWAY COMPANIES.

Company.	No. of Motors.	H.-P. Rating of Motors.	Total H.-P.	Length of Car.	Width of Car.	(Estimated.) Maximum Speeds, M. P. H.	(Estimated.) Maximum in City Limits.
Case							
1 Atlantic City	1	40	40	.....	.....	16	8
2 Austin, Texas	2	25	50	30 ft. 7 in.	7 ft. 9 in.	16	10
3 Atlantic City	2	40	80	.....	.....	16	8
4 Chicago & Indianapolis	2	55	110	41 ft.	8 ft. 4 in.	20	12
5 Conneaut & Erie	4	35	140	41 ft.	.....	20	10
6 Easton, Pa	4	40	160	40 ft. 1 in.	8 ft. 4 in.	20	..
7 Warren & Jamestown	4	50	200	52 ft. 14 in.	9 ft.	50	..
8 North Shore R. R., Cal	2	125	250	56 ft. 4 in.	.....	60	..
9 Chicago & Milwaukee	4	65	260	46 ft. 9 in.	.....	40	20
10 Indianapolis & Northwestern.	4	75	300	60 ft.	8 ft. 8 in.	42	..
11 Los Angeles-Pacific R. R.	4	80	320	55 ft.	.....	60	..
12 Interborough Rapid Transit, N. Y.	2	200	400	.....	.....	High-speed	Interurban
13 Schenectady Railroad, N. Y.	4	125	500	51 ft.	8 ft. 9 in.	70	..
14 N. Y. C. & H. R. R. R.	4	550	2,200	Locomotives		60	..

[1] For Part I see ELECTRICAL REVIEW, June 2, 1906.

urban problem. One fortunate factor which the practical engineer has at his disposal in solving such problems is the immense engineering resources of the larger manufacturing companies which are always placed willingly at his disposal.

Armstrong's Method—In a paper presented by A. H. Armstrong at the twentieth annual conventon of the American Institute of Electrical Engineers at Niagara Falls, N. Y., June 30, 1903,[1] was given a set of curves, Figs. 1, 2 and 3, from which could be determined the required motor capacity for a given service. These curves were plotted for

A. Trains of twenty cars or more;
B. Trains of two cars;
C. Single cars.

These curves are based upon a service rating which shows the relation between the commercial rated horse-power of a motor and the weight of car in tons it can propel at any speed without heating more than sixty-five degrees above the temperature of the air. The curves are plotted for a level track, gross acceleration of 120 pounds per ton; braking, 120 pounds per ton; duration of stops, fifteen seconds; coasting, ten seconds. To use the curves apply the following example:

Example—Given a forty-ton single car moving at thirty miles an hour, to determine the required motor capacity for a four-motor equipment. Refer to curve sheet C, Fig. 3, for single cars. The tons per motor would be ten. Referring to the curve sheet, note the intersection of the thirty-mile-per-hour curve with the ordinate ten tons per motor. Referring this point vertically to the lower scale on the abscissa may be found the required rated commercial horse-power per motor, in this case fifty-two. If there is considerable layover at the ends of the lines, the motor of the next smaller size manufactured by standard companies may be employed.

Armstrong's curves were based upon the friction curves plotted from the Davis formulæ. A more recent set of friction curves obtained by Armstrong is given in Figs. 4 and 5. They are based upon the formula,

$$R = 4 + 0.07\,V + \frac{0.0025}{T}V^2A\left(1 + .1\,(n-1)\right)$$

Where R = train resistance in pounds per ton,
T = weight of train in tons,
A = cross-section of car in square feet,
V = speed in miles per hour,
n = number of cars in train.

Referring to Figs. 4 and 5, the curves have been plotted in terms of speed in miles per hour, and train resistance in pounds per ton, for a car weight of forty-five tons, and a cross-section of 110 square feet. The curves indicate values for trains of various numbers of cars. Fig. 5 represents locomotive service.

Storer's Method of Determining Motor Capacity—This method serves in cases where a motor has been selected for a given service, and it is desirable to determine whether or not it has the proper capacity. Average speed time and power curves are drawn for this motor, and the effective current values determined. The average motor voltage over a whole cycle is also determined. The effective current value and this voltage value are referred to the characteristic curves of the motor. As the average potential will be in the vicinity of 400 or even 300 volts, the continuous capacity in amperes at these two potentials must be known. Usually a motor selected in this manner will have about twenty-five per cent excess capacity due to the fact that the ventilation is much better when mounted under a car than when the motor is mounted on a stand. This excess is on the safe side, and is particularly advantageous to the motor when operated by an incompetent motorman. Where greater accuracy is desired with this method, the original I^2R losses of the motor and its core loss at a particular voltage are found, and the total loss calculated. This value is compared with the heating value of the motor under similar conditions and its adaptibility for the service determined.[1]

Hutchinson's Method for the Determination of Motor Capacity—This method affords a means of determining the energy, the power, and the losses for any schedule speed, over a course of any length, with any initial acceleration, tractive resistance or braking effort, and with any desired use of the "motor curve." The paper[2] describing this method was presented before the American Institute of Electrical Engineers in January, 1902. It will be found in the transactions, vol. xix, page 129, and is one of the greatest classics on this subject.

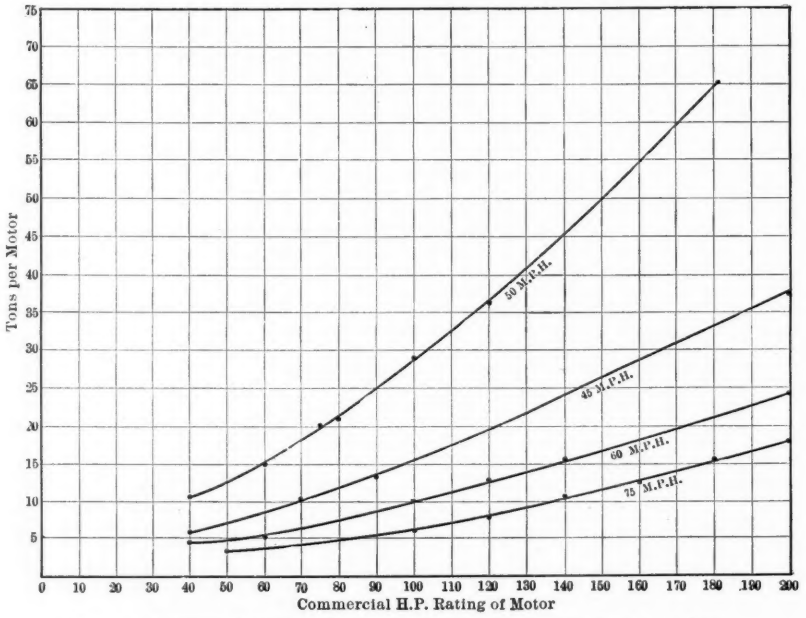


FIG. 1.—SERVICE CAPACITY CURVES—TRAINS OF TWENTY CARS OR MORE.

Discussion of Schedules—The initial rate of acceleration deserves great attention when selecting a motor equipment for a local service. There has been a tendency of late to use high initial rates of acceleration with a view to lowering the watt-hour consumption per ton-mile for a given schedule. The results have not been altogether satisfactory except where the motors were designed with low core losses, as was the case with some of the recent installations like that of the Interborough Rapid Transit Company's of New York. A rate of acceleration of 1.5 miles per hour per second seems to be the most satisfactory. This rate of acceleration is the standard for many railways throughout the country. Referring to Fig. 6, which is reproduced from Hutchinson's paper, this point is at

[1] See ELECTRICAL REVIEW, vol. xliii, page 7, July 4, 1903.

[1] *Street Railway Journal*, January 5, 1901.

[2] See ELECTRICAL REVIEW, vol. xl, pages 137 and 165, February 1 and 8, 1902.

once obvious. For instance, with a through acceleration of 0.3 (through acceleration = average speed between stations divided by the running time between stations) the watt-hours per ton-mile are approximately 115 for an initial rate of acceleration of one. Where the initial rate of acceleration is 1.5 the watt-hours per ton-mile become ninety-eight and, where it is two, the watt-hours are approximately ninety-two. When it is considered that the motor equipment is directly proportional to the rate of acceleration, or in other words the current used while accelerating, taking the one-hour rating as a basis, it is obvious that it would be advisable to consider a difference in watt-hour consumption of 115 compared with ninety-eight. On the other hand it would be hardly justifiable to consider a difference between ninety-two and ninety-eight. The increased motor capacity in the latter case at two miles per hour per second would hardly be economic.

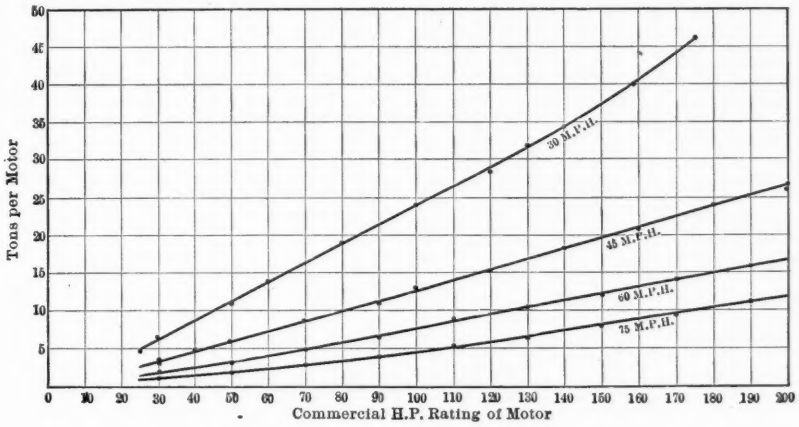


FIG. 2.—SERVICE CAPACITY CURVES—TRAINS OF TWO CARS.

Another point. Throughout the consideration of an entire problem the fact must be borne in mind that the heating of a railway motor determines its capacity. If the motor is overloaded, the armature coils will burn out, causing delay and expense. Consequently, there should be a reasonable proportion of coasting. Unfortunately delays are caused at stations by loading and unloading of passengers, with the result that the motorman eliminates the coasting, obtains a higher through acceleration, consumes more energy than ordinarily, and overheats the motors. As brought out by Mr. Hutchinson, a motor can dissipate about one-quarter of its rated losses continuously, on the assumption that the losses are about twelve per cent. Consequently, in order to produce an equilibrium of temperature, a motor should not develop twelve per cent of its rating in heat for more than twenty-five per cent of the time. On long grades there is a tendency for a motor to overheat.

Graphic Time-Table—Having determined, as indicated in Part I, the number of miles of track, the frequency of traffic and the size, type and seating capacity of cars for a given service, the motor capacity may be determined as indicated, by one of the methods outlined above. The question of distribution of cars should next be considered in order to calculate power-house capacity, size and distribution of substations. A proposed time-table is prepared such as will accommodate the possible traffic most economically. A clear conception of the distribution of trains during a day may be formed by means of what is termed a graphic time-table. This table or chart is plotted in terms of station stops or distance and the time values representing the various hours of a day. The location of each train during the day at the various time intervals is indicated on this chart. From such charts, many features are obvious, such as the passing of trains, location of turnouts on single-track roads, variation of speed of trains, changes in roadbed due to curves or grades, and many other features.

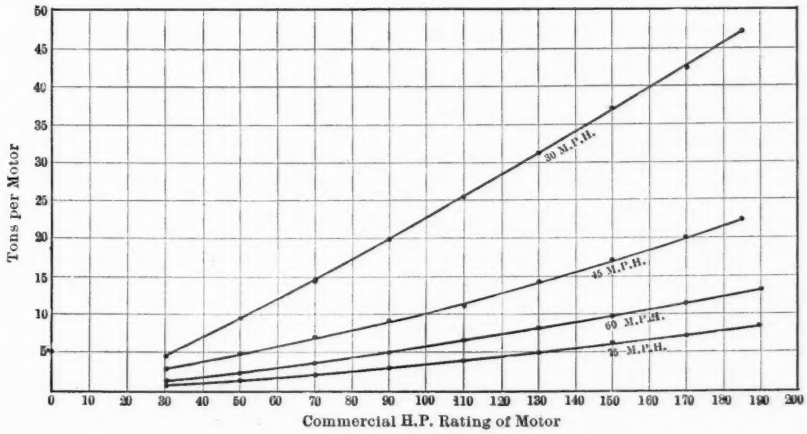


FIG. 3.—SERVICE CAPACITY CURVES—SINGLE CARS.

Energy Curves, Load Diagrams—Granting that all preliminary problems relating to schedule, size of cars, control and motor capacity have been considered, the next feature of importance is to calculate the amount of electrical energy required by the cars, and furthermore, to decide upon the most economical method of generating and distributing this energy.

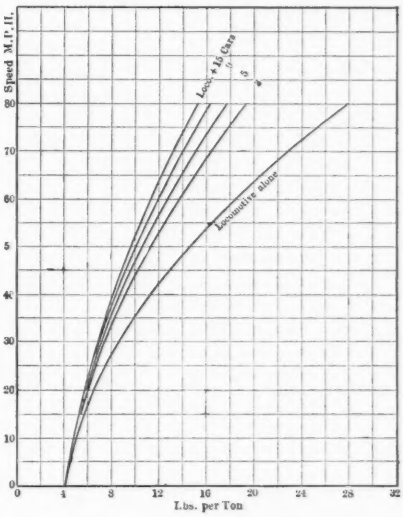


FIG. 4.—TRAIN FRICTION CURVES—LOCOMOTIVE TRAIN.

Starting with a single car or train unit, speed-time and energy curves should be plotted for an entire day, representing complete service. From sets of these curves corresponding to various cars may be determined their average watt-hour consumption per ton-mile. This may be determined mathematically, as outlined in Hutchinson's method of determining motor capacity for a level tangent track, but in actual practice the conditions are so varied that the former method is preferred.

Having determined the average watt-

hour consumption, some idea of the total required energy consumption per day may be gained. Knowing the car-mileage facilitates this determination. Then the load-factor of the proposed service is determined and the desired installed capacity becomes apparent.

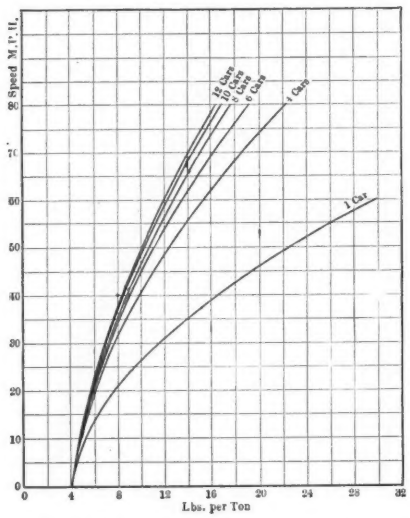


FIG. 5.—TRAIN FRICTION CURVES—MOTOR-CAR TRAINS.

In order to determine the load-factor, it is necessary to plot graphically on a chart the energy consumption of each train or single car for a single typical day, the abscissæ for this chart being time and the ordinate kilowatts. The kilowatt values are obtained from the energy curves plotted in connection with the speed-time

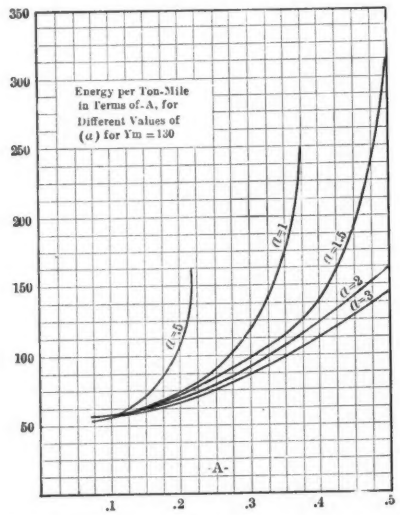


FIG 6.—THROUGH ACCELERATION CURVES.

curves previously mentioned. The energy values may be taken at as frequent intervals as the character of the service necessitates. For instance, with trunk-line service the power is on for a much longer period of time than with interurban service and consequently the time intervals may be reasonably long. With trolley service the period in which the power is on is quite short. When the train energy values for an entire day's service have been plotted on this chart the values should be summed up and a curve termed the load diagram will be the result. Sometimes it is interesting to pass curves through the points representing the energy consumption of the individual trains.

From the load diagram the average load value may be quickly determined by means of a planimeter, and with the average and the maximum values, the load factor is at once determined. This method was used on a large scale by Bion J. Arnold when making a preliminary report upon the proposed electrification of the New York Central & Hudson River Railroad. In the problem treated by Arnold the purpose was to substitute electricity for steam. Dynamometer tests were made upon steam locomotives in use and the results compared with proposed electric service. This problem was discussed by Mr. Arnold in a paper[1] presented before the American Institute of Electrical Engineers on June 19, 1902, in which may be found load diagrams of the New York Central & Hudson River Railroad problem.

Location of Power-House—It is impossible to give any general solution for the location of a power-house of a railway proposition, except that it should be located as near the load centre of the system as possible. When treating such problems it is customary to consider several sites near the load centre with reference to elements such as cost of real estate, use of river water for cooling condensers, transportation of coal, ashes, etc., insurance, and proximity of resident sections. The method of generation and distribution to be used depends upon the distance over which the system extends.

Location of Substations—The location of substations for a railway proposition is usually determined by certain fixed centres of load which develop with almost every proposition. As an example, assume that there is under consideration an elevated railway consisting of several branches. If the traffic is heavy it often becomes desirable in such cases to locate substations near the junctions of the two structures, and to use the elevated structure for the return circuit. This results in great economy of copper, for, if a twelve per cent loss in the feeders is allowable, nine per cent of this can be in the positive feeders, and three per cent in the negative feeders. It is found in practice that the carrying capacity of an elevated structure, when well bonded, is very great. Where tunnels sheathed in metal are used, it is usual to employ the sheathing of the tunnel for the negative circuit.

Where the traffic on a road is light and the system is not complicated, Kelvin's law may be used to advantage in the location of substations, as shown by C. W. Ricker in a paper[1] presented before the American Institute of Electrical Engineers, December 15, 1905.

Conclusion—From the foregoing discussion of the engineering preliminaries of an electric railway, it is obvious that considerable engineering ability is required to engineer a new proposition. With railway work the conditions are so varied in different localities that the only thing which can be systematized is the method of treatment. This has been the purpose of the writer. In doing this in a limited space it has been necessary to omit many small working details, and simply to refer to prominent engineering papers bearing on the subject rather than to abstract them.

[1] See ELECTRICAL REVIEW, vol. xli. page 104, July 26, 1902.

[1] See ELECTRICAL REVIEW, vol. xlviii, page 13, January 6 1906.

September Telephone Gain in New York Breaks all Records.

During the month of September, the New York Telephone Company and the New York & New Jersey Telephone Company secured a net gain in New York city of 7,584 new telephones, which is over 1,000 more telephones than were ever gained in this territory in any previous month. New residence telephones to the number of 3,500 were secured, which indicates the extent to which the telephone is being used in the home life of the city.

Ten years ago, in 1896, the gain for the entire year was less than half the number of telephones gained during this one month of 1906. The total gain in New York city for 1905, which was about 50,000 telephones, will be exceeded this year about at least 10,000.

The latest statistics and estimates obtainable show that in all probability the gain in telephones in New York city during the current year will exceed the telephone gain for all Great Britain.

New York is already the best telephoned city in the world, not only as regards the number of telephones, but also in the matter of efficient service. As the telephone companies point out, the fact that every telephone added to the system increases the value of the service to each user has become an important factor in this growth.

Realizing that by subscribing to telephone service they can reach not only all points in the city or suburbs, but practically every city and town of importance in the United States, business men have come to regard the telephone as a necessity. They find that the use of it saves them time, travel and money. It would be difficult indeed to estimate the value to New York city of the efficient telephone service with which it is now supplied.

American Electrochemical Society.

The tenth general meeting of the American Electrochemical Society was held in New York city, October 8 and 9.

The first meeting for the discussion of papers was held at Havemeyer Hall, Columbia University, at 10 A. M., October 8. The society was welcomed to Columbia University by Professor C. F. Chandler, who expressed the pleasure of the university in having one of the youngest scientific associations accept its hospitality. He pointed out the great field open to the society, and showed what revolutionary changes have already been made in chemical processes by making use of electrolytic reactions. He thought that the aid which chemistry would derive from electrical methods would be far greater in the future than it has been in the past. On behalf of the society, President Hering thanked Professor Chandler, and through him the university, for its courtesy and good wishes.

A paper entitled "Formula for the Helmholtz Concentration Cell," submitted by Professor Henry S. Carhart, was read by Dr. W. D. Bancroft. The paper starts with the well-known Helmholtz equation, and shows that when applied to a concentration cell the expression for the electromotive force reduces to $E = T\ d\ T$, which shows the relation between the Helmholtz and the Nernst equations, and indicates that the latter may be derived entirely from thermoelectric data. The values obtained by calculation, using this formula, give results of the same order as those observed.

The paper was discussed by Carl Hering and Dr. Bancroft, the former asking whether the equation, as proposed, was in agreement with the second law of thermodynamics, and the latter calling attention to the fact that the relation deduced had been pointed out in 1899.

A paper entitled "Visible Migration of Particles between Electrodes," was read by Carl Hering. This described the behavior of minute particles of matter when in a fluid placed between two electrodes, when observed by means of a microscope. It was found that these particles responded to the action of the current and traveled in one direction or the other. Occasionally particles of two kinds were found in one mixture, these moving in opposite directions. They seemed to exert a mutual repulsion, as they deviated from their paths in passing one another. No attempt to explain this was made, but it was thought that the phenomenon might account for irregularities occurring in electrolytic processes, particularly when oxidation occurs at the cathode or particles of foreign matter are found to be contained in the deposited material. The speed of these particles was about one foot in four hours.

Dr. Bancroft thought that the phenomenon was merely a reversal of ordinary endosmose. In this case the diaphragm, being disintegrated, could move, as well as the liquid. As there are two kinds of diaphragms the particles of one would move in one direction and those of the other in the opposite direction. He did not think it explained oxidation at the cathode, but was the more inclined to attribute this to local chemical action.

Mr. Hering did not agree with these comments, but thought that the disintegrated diaphragm would always move with the liquid, and that no other explanation had been offered for finding inactive material, such as carbon, in a deposit of iron.

C. A. Acker, of Niagara Falls, called attention to a recent patent issued in this country which claimed an electrolytic process in which foreign particles were introduced into the solution, which particles all moved in one direction. This process, it was explained, contemplates the use of gelatine or some gum, and that the transferred particles collect upon the high points of the plated surface, and in this way, by introducing a resistance, assist in building up the lower parts.

E. A. Sperry called attention to the process employed by Betts in refining lead, in which gelatine is used, and wished to know what difference there might be between the two.

Dr. Bancroft explained that Betts made use of gelatine because he found it effective, while the patentee of the new process had found that gelatine, under the action of the current, would move toward the cathode, and would therefore be effective.

A paper by J. W. Turrentine, entitled "Copper Cathodes in Nitric Acid," was read by Dr. Bancroft. This described an investigation of the action taking place when copper cathodes are used in nitric acid. The action at the anode is the formation of copper nitrate; that at the cathode the reduction of nitric acid, nitric acid or ammonia being set free, according as copper is in the solution or not.

A paper entitled "An Aluminum and Magnesium Cell," presented by G. H. Cole and H. T. Barnes, was read by Dr. Bancroft. The cell consists of a solution into which a magnesium and an aluminum plate are introduced. There is a momentary flow of current from the aluminum to the magnesium, and then the cell reverses and current flows in the opposite direction through the solution. When hydrogen peroxide is introduced as an oxidizer, an electromotive force of 2.14 volts is obtained.

Dr. M. Loeb thought the action of the cell might be explained by the effect of magnesium upon water, which it decomposes. The hydrogen set free might then react with the hydrogen peroxide. No explanation, however, was given why this cell, if it were a hydrogen-oxygen cell, should develop such a high electromotive force.

A paper by Francis R. Pyne, entitled "Melting Points of Some Cryolite-Alumina Mixtures," was read in abstract by S. S. Sadtler. Mr. Sadtler also read a paper presented by P. B. Sadtler and W. H. Walker, entitled "Double Decomposition of Zinc Sulphate and Sodium Chloride," and a paper by H. E. Patten, entitled "Some Factors Affecting the Distribution Law," this being a study of the absorption of liquids by polarized solids.

The reading and discussion of papers was resumed on Tuesday morning at 10.30 o'clock. It was opened by Dr. E. F. Roeber, who discussed the subject of temperature measurements, showing that temperature is merely a relative term and all methods of measuring are based upon the changes taking place in the substance as it is heated or cooled. Attention was called to the great progress made recently in the construction and use of pyrometers, and the necessity for international agreement in the use of fixed points for calibration was dwelt upon.

A paper entitled "A Thermoelectric Pyrometer for General Industrial Applications" was read by F. F. Schuetz. This described the newest forms of Bristol pyrometer as developed for industrial use. The requisites for a practical pyrometer are that it must be accurate and capable of being handled by ordinary workmen. The Bristol pyrometer was described in the issue of the ELECTRICAL REVIEW for May 12, 1906. It depends upon thermoelectric effects, and the couples are mounted in different ways for different purposes. The fire tips for these pyrometers intended for very high temperatures may be replaced, while the extension piece is permanent. The latter may be twenty feet in length or more. For indicating instruments Weston millivoltmeters are used, and for recording instruments the record is made on a smoked dial, the recording needle standing normally free

from the paper, but being brought in contact with it by vibrations set up in the paper itself. In this way friction is eliminated and a continuous record secured. The pyrometer has been developed in various styles, for various purposes, and by making use of relays is adapted for automatically controlling oven temperatures. The resistance of the units varies from two to ten ohms, so that a fairly large actuating torque is secured. The indicating instruments may be provided with two scales, one reading to 750 and the other to 2,000 degrees. With the combination pyrometers—that is, those suited for high temperatures—platinum-rhodium couples are employed, and these are so attached to the leading-in extension piece as to neutralize the effect of heating at that point.

F. H. Whipple, of the Cambridge Scientific Instrument Company, described English practice in the development and use of pyrometers, referring particularly to those of the resistance type. He showed the construction of these by means of a number of lantern slides. Other types of pyrometer were described by those who took part in the discussion.

Professor F. B. Crocker read a paper entitled "The Decker Primary Battery." He reviewed the history of primary batteries, showing that no improvement in the type of cell has been made since 1842, with the exception of the Lalande cell, which is not a power cell, and the Bunsen. No advance in structural features has been made since 1850. He had discussed this matter before a meeting of the American Institute of Electrical Engineers in 1888. He believed the cell to be described to be the first real advance in the mechanical design of a primary battery that has been made since 1842. This cell is of the zinc-carbon-sodium bichromate type. The principal feature is the method of construction. Porous cups are formed by burning together two halves of porcelain of considerable thickness, ribbed on the inside for strength, and then grinding down the outside so as to leave a thickness of shell comparable to paper. These cups are mounted permanently in hard-rubber vessels, and graphite plates are placed on the sides, also mounted permanently, great precautions being taken to prevent any corrosion of the electrodes. The zinc plates are introduced into the porcelain cups, the connection being such as to avoid corrosion here. All connections, excepting those of the zinc, are made permanently, and are brought through the sides of the rubber jar. Three or more of these jars are united together and vulcanized so as to form one solid piece. The lower part of each cup is provided with an opening into which a hard-rubber tube leads, the joint being made acid-tight. This tube leads down into a conduit which is provided in the base of the cell, and which connects with a similar conduit to the next cell. This provides for circulation of the electrolyte, and although it allows slight local action to take place, this is not serious. The cells are charged by replacing the old zincs by new, drawing off the old solution through openings provided at the bottom and introducing fresh. A battery made up of three cells, each weighing when filled seventeen pounds, the total battery, therefore, weighing fifty-one pounds, gives an output of 160 ampere-hours at a discharge rate of thirty amperes, the average voltage being 1.7. This corresponds to about one horse-power. The zincs will last for three charges of electrolyte. As the solution makes up about half the weight of the entire cell, by providing two reservoirs, each containing two charges of solution, the output of the cell is increased three by simply doubling the total weight. It has been figured out that power may be obtained from this cell for thirty-five cents per horse-power-hour. While, on its face, this could not be compared with electrical energy supplied from a dynamo, or even from a storage battery, all things considered, such as convenience, the quickness with which the cells may be recharged and the value of the waste product which may possibly be regenerated, there would seem to be a field for such sources of electrical energy. This applies particularly to vehicles, for train lighting and for launches. As an indication that the cost of power would not be fatal, it was pointed out that the cost of energy from a Lalande battery is about $5.30 per horse-power-hour, a figure which is not prohibitive for certain purposes. The internal resistance of the battery is 0.013 ohm per cell. The leakage current is about one-twentieth ampere for a thirty-volt battery. These batteries have been undergoing tests for the past two years, particularly on an electric vehicle, and have withstood successfully very severe work. The voltage remains nearly constant until the end of the discharge is approached. The leakage current corresponds to a "zinc efficiency" of eighty-five per cent, and this does not seem to be affected by lower rates of discharge.

The social features of the meeting were rather informal. On Monday afternoon a lecture by Dr. Charles Baskerville, on "The Use of Ultra-Violet Light in the Laboratory and in Practice," was given at the College of the City of New York. In the evening an informal dinner was held at Liederkranz Hall, and during the afternoons various points of interest were visited. The hotel headquarters was at the Prince George Hotel, while the Chemists' Club and Liederkranz Hall were thrown open to all the members.

HOW ELECTRICITY WAS SERVED TO CONSUMERS AND STREET CAR LINES BY THE SAN FRANCISCO GAS AND ELECTRIC COMPANY AFTER THE FIRE.[1]

BY L. E. REYNOLDS.

In order to get a clear idea of how San Francisco was supplied with light and power to consumers and street car lines after the fire of April 18, 19 and 20, it will first be necessary to go over the normal condition of its distributing system as it existed previous to this time. It is as follows:

The down-town section was furnished by a complete Edison system of three-wire, 220-volt, direct-current tube for lights and power. This was composed of about 130,000 feet of main on standard Edison tube and 95,000 feet of Edison tube feeders. The mains were placed on either side of the street so that services were tapped off direct to the building. These mains terminated in fused junction boxes at street intersection. The feeders extended fan-like from the station to various junction boxes, and did not directly supply any consumers. There was also a complete system of alternating-current mains of 220-volt, two-phase, four-wire, supplied by subway transformers, which in turn were connected to 2,200-volt feeders. The alternating-current mains were installed by the Independent Electric Light and Power Company, and are usually parallel with the Edison system. This system contains approximately 160,000 feet of conduit, ranging from four to sixteen ducts. There are also 1,050 manholes, which contain junction boxes, fuse boxes, and subway transformers. Within this conduit system there are installed 102,500 feet of 11,000-volt, three-conductor, three-phase cable, and 10,000 feet of 4,500-volt, three-conductor, three-phase cable; 75,000 feet of 2,200-volt, four-conductor, two-phase cable; 130,000 feet of 220-volt, two-phase, four-conductor cable; 240,000 feet of miscellaneous cable, supplying service, special installation, direct-current cables in conduit system, etc. Outside the fire limits the distribution is carried on poles in the usual manner, having installed approximately 10,000 poles and 1,500 miles of wire.

The steam plant known as Station A is located at Twenty-third and Georgia streets, and contains about 30,000 horse-power of steam plant capacity. This plant is also connected by two lines to the Martin power-house, which is a gas-engine

[1] Paper read at the fourteenth annual convention of the Pacific Coast Gas Association, San Francisco, September.

generating station, having approximately 16,000 horse-power capacity. Two lines extend south from the Martin power-house and connect with the water-power system of the California Gas and Electric Corporation. The capacity of the lines between the Martin power-house and Station A is 12,000 horse-power. The larger portion of this energy was transmitted directly to the central substation on Jessie street between Third and Fourth streets, having a capacity of 3,800 kilowatts in motor-generator sets, 2,000 horse-power in steam engines, and 1,500 kilowatts in storage batteries, 3,000 horse-power in steam-generating apparatus having been destroyed February 22, by fire.

Substation No. 1 was at Fern avenue, between Polk and Larkin streets. It contained 500 kilowatts in motor-generators and 250 kilowatts of storage batteries feeding directly into the Edison system.

Substation No. 2 was on Minna street, between Eleventh and Twelfth streets, containing 500 kilowatts in motor-generators and 250 kilowatts of storage batteries.

Substation No. 3 was on Pacific street, between Dupont and Stockton streets, containing 500 kilowatts in motor-generators and 250 kilowatts of storage batteries, also one fifty-light arc transformer.

Substation No. 4 was an alternating-current station, on Eighth street, between Mission and Howard streets. This station was used as a switching station between Station A and the other alternating-current substation. It contained 2,000 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers, also an arc transformer for taking care of 800 city arcs, one 400-kilowatt rotary converter, 550 volts, direct current, for delivering energy to the street railway. Also one 250-kilowatt rotary converter, 220 volts, delivering energy into the Edison system. This substation received its energy from four underground 11,000-volt, three-conductor cables from Station A. Also one overhead line of three-conductor, as far as Seventh and Folsom streets, thence underground for three blocks, and after passing through switches goes directly to central substation. There is also an overhead line from Station A as far as Seventh and Folsom streets, thence underground directly to central station. From substation No. 4 there were two lines to each of the other alternating-current stations, which were located as follows:

Substation No. 5, Mission street between New Montgomery and Third streets, containing 2,000 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers and 250 kilowatts in motor-generator sets delivering direct-current energy into the Edison system. One 400-kilowatt, 500-volt rotary converter capable of supplying energy to the United Railroads. This station was supplied from two 11,000-volt cables from substation No. 4.

Substation No. 6 was located on Sacramento street, between Sansome and Montgomery streets, containing 1,500 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers, and one 250-kilowatt rotary converter, delivering 220-volt energy into the Edison system. This station was supplied by two 11,000-volt cables from substation No. 4.

Substation No. 7, on Hyde street, between Golden Gate avenue and McAllister street, contained 2,500 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers, receiving its energy from two 11,000-volt cables from substation No. 4.

Substation No. 8 is at Townsend street, between Second and Third streets, and contains 850 kilowatts capacity in motor-generator sets, delivering energy into the Edison system.

There is also a Kansas street station, on Kansas street near Division street, which was used as a switching station, receiving water-power energy and also steam energy, and delivering same to substations 1, 2, 3 and 8, as these were all fed by overhead lines.

The earthquake and fire did not even crack the walls or do any damage at Station A, except one transformer burnout. The machine foundations for this station were made by blasting out the solid rock, and then building up on large masses of concrete. The walls were of brick laid in cement mortar, and same is as good as before the earthquake.

Central station had its steam plant destroyed, also all the wiring and switchboards, on February 22 of this year, so that the subway with its wires, also switchboard, were only temporary, being installed as quickly as possible after the other fire. The substation portion of this building was fireproof, and except for the fact that a six-story brick wall fell on the roof, caving it in the running motor generator room, the station would not have suffered much damage. The high tension switching apparatus, containing large quantities of oil, did not burn. Office furniture and records of superintendent stations, also locker room and store room for supplies, remained intact and did not burn, although in this vicinity fire was as hot as anywhere in the burned district. This substation was composed of brick exterior with wire-glass windows and slate roof. The motor generator sets were damaged after the roof had been broken down with large masses of brick and steel from the adjoining building, and a crane which was used for the installation of motor generators was brought down on top of them.

Substations 2, 3, 4, 5, 6 and 7 were completely destroyed, so that we had no further use for them.

Substation No. 8 was saved by the exceptionally good work done by its operator, Mr. Fay. A steam boiler was used in the rear of substation No. 8 to pump oil from the bay to the central station, also for circulating water. A fire pump was installed in the basement of B station, which was just across the street from substation No. 8. Mr. Fay kept this fire-pump going, pumping salt water on the surrounding buildings until B station was ready to fall. He then left the pump going and worked the hose, keeping his own station and several warehouses near-by from being destroyed. The station was not damaged at all.

The four underground cables from Station A to substation No. 4 were so badly wrecked by the earthquake and gas explosion that they were out of commission some ten or twelve days. The overhead lines were burned down for four blocks. The underground extension of these lines was so badly damaged that the conduit and manholes had to be reconstructed in many places. Along Seventh street, from Mission to Howard street, the earth was displaced from five to eight feet in a direction lengthwise to conduit. This caused some of the manholes to crush like eggshells, although they were twelve-inch concrete walls. The conduit was pulled apart at other places, and cables were wrenched and torn from their boxes, and in some cases pulled apart between manholes, so that these breaks were not discovered until after we had tested with full voltage. Five different attempts were made before we succeeded in establishing connections between Station A and the central station. The overhead line was replaced on Seventh street for four blocks. A temporary overhead line was built from the Kansas street station to substation No. 8.

The underground Edison system had services tapped off into the basements, which had been ruined, so that every joint had to be dug up and cleared before service could be reestablished on the main itself. Fortunately for the public, it was not necessary to wait to clear all of these mains, as it will probably be several

months before we can open the street because of piles of débris over them. Since all of our alternating substations with their apparatus have been destroyed, and also since we could not reestablish connection with our Edison mains completely for some months, it was decided to abandon the alternating-current system of distribution for the underground section and use the cables for direct current. We therefore had service where same was needed before the building stopped smoking, and light was established in the banks and those buildings which were not burned, as soon as it was needed. Each block of main had to be gone over, however, removing all services therefrom and tested out carefully before the main could be used.

In addition to the substation mentioned above, during heavy load last winter we found it necessary to build an overhead cross-town line from Station A over Mariposa and Seventeenth streets, tapping Folsom and Mission streets, running west as far as Stanyan street, and thence north to Fulton street, thence west to First avenue, thence north to Washington street. The function of this line was to boost up the outer end of feeders so as to keep a uniform potential at long distances from substations. Pole transformers were installed on this line, transforming directly from 11,000 volts to 2,200 volts as load required. Two 750-kilowatt step-down transformers were installed at Seventeenth street, near Folsom street, which take care of all of the unburned section of the Mission for power and light. One transformer for 200 city arcs was also installed in the temporary station, and a fifty-kilowatt light transformer which was formerly at substation No. 3 was repaired and installed here. Thus all except about 100 of the street lights in the unburned section of the Mission were provided for. These had to remain out until we could get apparatus for their control.

The Western Addition was supplied by two 750-kilowatt transformers placed on the sidewalk at First avenue near Point Lobos. Here, also, was placed a transformer for 200 city arcs. This provided for all the city arcs in the Western Addition with the exception of 100 which were purposely scattered.

On the morning of the eighteenth, as the fire was approaching the storeroom where all distribution supplies were maintained, we succeeded in removing one buggy-full and one automobile-full of linemen's tools, tape, solder and such small supplies as we could get hold of, quickly to a place of safety. As soon as the men had taken care of their families temporarily, the company established a commissary department, setting aside one wagon and two soldiers to collect food to provide for the men and their families. It was necessary in order to keep the men to care for them in this way. A mess house was established and they were boarded until better accommodations could be obtained. We thus kept a large force of men busy when we needed them most. Regular work was organized on Saturday, the third day after the earthquake, and 100 city arcs were ready to burn on Saturday night and 200 more were ready Sunday night, and so on the work progressed. On Monday many of the houses were lighted in the Western Addition. From then the work was carried on very rapidly with constantly increasing speed. We were also very busy as soon as we could get teams, picking up our copper which had fallen down from burned lines. We regained about $60,000 worth of this metal from the streets. Every house in the unburned portion of the city which had previously been lighted by electricity had to be disconnected from the main before current could be turned on at all. Then service was established one block at a time on the company's mains after the same was inspected very carefully. Before each house was connected it was inspected by the department of electricity and also by one of the company's experts, and a careful test was made for broken wire and grounds. Service was then restored.

In order to get service for the street railway the energy from the water-power plant and also the steam plant from Station A, which has a frequency of sixty cycles, must pass through frequency changers at the Martin power house, where it is changed to 13,000 volts at twenty-five cycles, three-phase. Two lines of 13,000 volts, three-phase connect the Martin power house with the Geneva avenue station, which in turn connected with the Turk and Fillmore streets station and steam plant at North Beach belonging to the United Railroads. There are also two other 13,000-volt, twenty-five-cycle lines from the Martin power house to the Bryant street station, which is also connected by two lines to meet lines between the Geneva avenue and Turk and Fillmore streets substation. It was possible to run the frequency changers as soon as the United Railroads had cleared their trolley so as to be ready to receive energy. Connection was reestablished in the usual manner and cars were immediately allowed to run.

It may be interesting to note that in the substations where lead-covered cables extend from the main floor through tubing to the subway, that the lead was not melted off the cable more than six inches below the floor line. This was true in substations where the second floor contained oil transformers, which allowed their contents to run down the walls and burn on the floor. The fire was so hot in these stations that one could peel off with their fingers from one to one and one-half inches of the solid brick wall which had been laid in cement. In one case the wood trap door into the subway burned away, but directly underneath and about two feet away was a pile of old rags containing oil and grease, which did not ignite. In another station five gallons of gasolene remained in the tunnel with the trap door burned away, while the building burned down and was also dynamited.

Two Cities Left in Darkness Because of the Breaking of a Canal Bank.

An accident to the plant of the New Milford Power Company, New Milford, Ct., on Sunday morning, October 7, left the cities of New Britain and Waterbury in darkness for several days. In addition to this the trolley service in the New England towns between Waterbury and New Britain was demoralized.

The accident was caused by the breaking away of the bank of the canal which leads from the company's dam at Merwinsville to the turbines at Bull's Bridge, where the power-house is located. The raceway is built of earth, without masonry, and a leak in a section of it which runs through marshy ground had been disregarded. On Sunday morning 100 feet of this embankment gave way and the water flowed into the Housatonic river. No damage was done except to the embankment.

General Electric Company to Issue New Stock.

It is anounced that the directors of the General Electric Company will shortly issue the $5,000,000 of stock in the company's treasury and make provision for an additional stock issue. The matter has been under discussion for some time, and in all probability the amount of stock to be issued, including that now in the treasury, will be close to $11,000,000, or twenty per cent of the outstanding capitalization of $54,000,000.

The Street Railway Convention.

Programme of the American Street and Interurban Railway Association and the Engineering Association; the Special Trains; the Exhibits of the Manufacturers' Association.

THE annual meeting of the American Street and Interurban Railway Association, together with that of the Engineering Association, the Accountants' Association and the Claim Agents' Association, will be held at Columbus, Ohio, October 15, 16, 17, 18 and 19.

A fine programme of papers has been prepared, the entertainment features have been in capable hands and it is expected that the Manufacturers' exhibit will be far ahead of previous years.

The convention sessions will be held at the Ohio State Fair grounds, where the Manufacturers' exhibit will also be held.

The following programmes have been announced:

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

WEDNESDAY, OCTOBER 17, 10 A. M. to 12.30 P. M.—Convention called to order; address of welcome; president's address; report of executive committee; report of secretary and treasurer; addresses by presidents of affiliated and allied associations; announcements; new business.

WEDNESDAY, OCTOBER 17, 2 P. M to 4.30 P. M—Reports of committees: (a) membership; (b) compensation for carrying mail; (c) subjects; (d) car wiring; (e) standardization of equipment; (f) insurance; (g) promotion of traffic.

THURSDAY, OCTOBER 18, 10 A. M. to 12.30 P. M. (Interurban Meeting).—Report of committee on heavy electric railroads. Paper—"Elevated Railways and Their Bearing on Heavy Electric Traction," by H. M. Brinckerhoff, consulting engineer, New York city. Paper—"Electric Railways in Sparsely Settled Communities," by E. P. Roberts, of the Roberts & Abbott Company, Cleveland, Ohio. Paper—"Interurban Limited Trains," by Harrie P. Clegg, president Dayton & Troy Electric Railway Company, Dayton, Ohio. Paper—"Interurban Freight and Express," by E. C. Spring, general manager Dayton, Covington & Piqua Traction Company, West Milton, Ohio. Paper—"Tickets and Rates," by F. W. Coen, secretary and treasurer Lake Shore Electric Railway Company, Cleveland, Ohio. Paper—"Some Distinctions Between City, Suburban, Interurban and Railroad Traffic," by Theo. Stebbins, expert, National Civic Federation, Cohasset, Mass. Appointment of nominating committee.

THURSDAY, OCTOBER 18, 2 P. M. to 4.30 P. M. (Employés' Meeting).—Report of committee on rules. Paper—"Y. M. C. A. Branches," by E. M. Willis, railroad secretary international committee of Y. M. C. A., New York city. Paper—"Selection of Trainmen," by C. E. Learned, superintendent of inspection Boston Elevated Railway Company, Boston, Mass. Paper—"Discipline of Trainmen," by F. W. Brooks, assistant general manager Detroit United Railway, Detroit, Mich. Paper—"Uniforms and Badges," by John R. McGivney, purchasing agent New Orleans Railway and Light Company, New Orleans, La.

FRIDAY, OCTOBER 19, 10 A. M. to 12.30 P. M. (Executive Session).—Report of committee on municipal ownership; report of committee on public relations. Paper—"Handling Public Complaints," by John A. Beeler, vice-president and general manager Denver City Tramway Company, Denver, Col. Paper—"Leaks Between Passenger and Treasurer," by A. H. Stanley, general superintendent Public Service Corporation of New Jersey, Newark N. J.

FRIDAY, OCTOBER 19, 2 P. M. to 4.30 P. M.—Report of nominating committee; election of officers; resolutions; unfinished business; adjournment.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

MONDAY, OCTOBER 15, 10 A. M. to 12.30 P. M.—Registration; convention called to order; address of welcome; address—Hon. W. Caryl Ely, president American Street and Interurban Railway Association; address—Prof. Bernard V. Swenson, secretary and treasurer American Street and Interurban Railway Association; reading of the minutes of the last meeting; address of the president; annual report of the executive committee; annual report of the secretary and treasurer; appointment of convention committees.

MONDAY, OCTOBER 15, 2 P. M. to 5 P. M.—Report of special committees; report of committee on control apparatus; report of committee on maintenance and inspection of electrical equipments; paper—"Ballast," by Charles H. Clark, engineer maintenance of way Cleveland Electric Railway Company, Cleveland, Ohio; report of committee on way matters; paper—"Ties, Poles and Posts," by C. A. Alderman, chief engineer, Cincinnati Traction Company, Cincinnati, Ohio.

TUESDAY, OCTOBER 16, 10 A. M. to 12.30 P. M.—Report of the committee on standardization. Paper—"Gas Engines," by Paul Winsor, chief engineer motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass. Paper—"Underground Cables," by H. G. Stott, superintendent motive power Interborough Rapid Transit Company, New York, N. Y.

TUESDAY, OCTOBER 16, 2 P. M. to 5 P. M.—Paper—"Economy of Car Equipment, Weights and Schedules," by E. H. Anderson, Schenectady, N. Y.; discussion of the question box.

TUESDAY, OCTOBER 16, 8 P. M.—Informal reunion and dinner.

WEDNESDAY, OCTOBER 17, 10 A. M. to 12.30 P. M.—Joint meeting with "American" Association.

WEDNESDAY, OCTOBER 17, 2 P. M. to 5 P. M.—General business; election of officers.

The railroads have granted the rate of a fare and a third on the certificate plan. The Manufacturers' Association has selected the New York Central line as its official route from New York city. The New York Central has made up a special train, with the following schedule: leave Boston, *via* Boston & Albany Railroad, 10.45 A. M., Sunday, October 14; Worcester, 11.45 A. M.; Springfield, 1.11 P. M.; Pittsfield, 2.59 P. M.; New York, *via* New York Central & Hudson River Railroad, 2.04 P. M.; Albany, 5.08 P. M.; Schenectady, 5.36 P. M.; Utica, 7.09 P. M.; Syracuse, 8.24 P. M.; Rochester, 10 P. M.; Buffalo, 10.52 P. M.; arrive Columbus, 6.58 A. M., Monday, October 15.

The Pennsylvania Railroad has announced a special train from New York to Columbus, leaving New York 8.25 P. M., Saturday, October 13, arriving at Columbus, 1.40 P. M., Sunday, October 14.

The following companies have made application for space at the Manufacturers' exhibit:

Allis-Chalmers Company, Milwaukee, Wis.

American Brake-Shoe and Foundry Company, Mahwah, N. J.

American Instrument Company, Philadelphia, Pa.

American Railway Supply Company, New York, N. Y.

A. & J. M. Anderson Manufacturing Company, Boston, Mass.

Armstrong Oiler Company, Philadelphia, Pa.

Atlas Railway Supply Company, Chicago, Ill.

American Mason Safety Tread Company, Boston, Mass.

American Steel and Wire Company, Chicago, Ill.

Atha Steel Castings Company, Newark, N. J.

Adams & Westlake Company, Chicago, Ill.

Acme Automatic Street Indicator Company.

Bayonet Trolley Harp Company, Springfield, Ohio.

Blake Signal and Manufacturing Company, Boston, Mass.

J. G. Brill Company, Philadelphia, Pa.

Harold P. Brown, New York, N. Y.

Buckeye Engine Company, Salem, Ohio.

Burnham, Williams & Company, Philadelphia, Pa.

Brady Brass Company, New York, N. Y.

S. F. Bowser & Company, South Bend, Ind.

L. M. Booth Company.

Cleveland Frog and Crossing Company, Cleveland, Ohio.

Consolidated Car Fender Company, Providence, R. I.

Consolidated Car Heating Company, New York, N. Y.

Cook's Railway Appliance Company, Kalamazoo, Mich.

Curtain Supply Company, Chicago, Ill.

Creaghead Engineering Company, Cincinnati, Ohio.

Cambria Steel Company, Philadelphia, Pa.

Carnegie Steel Company, Pittsburg, Pa.

Dearborn Drug and Chemical Works, Chicago, Ill.

D. & W. Fuse Company, Providence, R. I.

Duff Manufacturing Company, Pittsburg, Pa.

Dayton Manufacturing Company, Dayton, Ohio.

Joseph Dixon Crucible Company, Jersey City, N. J.

Duplicate Transfer and Rebate Company, Philadelphia, Pa.

DuQuesne Steel Foundry Company, Pittsburg, Pa.

Dossert & Company, New York, N. Y.

Dressel Railway Lamp Works, New York, N. Y.

O. M. Edwards Company, Syracuse, N. Y.

Electric Railway Equipment Company, Cincinnati, Ohio.

Electric Storage Battery Company, Philadelphia, Pa.

Charles I. Earll, New York, N. Y.

Electrical Review, New York, N. Y.

Electric Service Supplies Company, Chicago, Ill.

Eclipse Railway Supply Company, Cleveland, Ohio.

Franklin Car Heating Company, Syracuse, N. Y.

Franklin Electric Manufacturing Company, Hartford, Ct.

Felt & Tarrant Manufacturing Company, Chicago, Ill.

Galena Signal Oil Company, Franklin, Pa.

W. R. Garton Company, Chicago, Ill.

General Electric Company, Schenectady, N. Y.

Gold Car Heating and Lighting Company, New York, N. Y.

Goldschmidt Thermit Company, New York, N. Y.

Globe Ticket Company, Philadelphia, Pa.

Griffin Wheel Company, Chicago, Ill.

General Systems Company, Dayton, Ohio.

Hale & Kilburn Manufacturing Company, Philadelphia, Pa.

F. P. Harrison Electric and Manufacturing Company, Incorporated, New York.

Albert B. Herrick, Ridgewood, N. J.

Heywood Bros. & Wakefield Company, Wakefield, Mass.

George S. Hastings & Company, Cleveland, Ohio.

Helios Manufacturing Company, New York, N. Y.

Indianapolis Switch and Frog Company, Indianapolis, Ind.

Ingersoll Company, Pittsburg, Pa.

International Register Company, Chicago, Ill.

International Sprinkler Company, Philadelphia, Pa.

H. W. Johns-Manville Company, New York, N. Y.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.

Kinnear Manufacturing Company, Columbus, Ohio.

Keystone Brake-Shoe Company, New York, N. Y.

Lagonda Manufacturing Company, Springfield, Ohio.

Lorain Steel Company, Philadelphia, Pa.

Lord Electric Company, Boston, Mass.

George W. Lord Company, Philadelphia, Pa.

Lumen Bearing Company, Buffalo, N. Y.

Massachusetts Chemical Company, Walpole, Mass.

John W. Masury & Son, Brooklyn, N. Y.

Maryland Steel Company, Sparrow's Point, Md.

Miller Anchor Company, Norwalk, Ohio.

McGuire-Cummings Manufacturing Company, Chicago, Ill.

National Brake Company, Buffalo, N. Y.

National Brake and Electric Company, Milwaukee, Wis.

National Lock Washer Company, Newark, N. J.

Niles Car and Manufacturing Company, Niles, Ohio.

R. D. Nuttall Company, Pittsburg, Pa.

National Car Wheel Company, Pittsburg, Pa.

Ohio Brass Company, Mansfield, Ohio.

Ohmer Fare Register Company, Dayton, Ohio.

Pantasote Company, New York, N. Y.

Pressed Steel Car Company, Pittsburg, Pa.

Pennsylvania Steel Company, Philadelphia, Pa.

Pittsburg Insulating Company, Pittsburg, Pa.

Quincy, Manchester, Sargent Company, Chicago, Ill.

Rail Joint Company, New York, N. Y.

Recording Fare Register Company, New Haven, Ct.

Joseph T. Ryerson & Son, Chicago, Ill.

Frank Ridlon Company, Boston, Mass.

Sherwin-Williams Company, Cleveland, Ohio.

Southern Exchange Company, New York, N. Y.

Speer Carbon Company, St. Marys, Pa.

Standard Paint Company, New York, N. Y.

Standard Steel Works, Philadelphia, Pa.

Peter Smith Heater Company, Detroit, Mich.

Security Register and Manufacturing Company, New York, N. Y.

Standard Varnish Works, New York, N. Y.

Star Brass Works, Kalamazoo, Mich.

St. Louis Car Company, St. Louis, Mo.

Sterling Varnish Company, Pittsburg, Pa.

The T. H. Symington Company, Baltimore, Md.

Schoen Steel Wheel Company, Philadelphia, Pa.

St. Louis Car Wheel Company, St. Louis Mo.

Sterling-Meaker Company, Newark, N. J.

Taylor Electric Truck Company, Troy, N. Y.

Trolley Supply Company, Canton, Ohio.

United States Metal and Manufacturing Company, New York, N. Y.

United States Engineering Company.

W. T. Van Dorn Company, Chicago, Ill.

Van Dorn & Dutton Company, Cleveland, Ohio.

Wallace Supply Company, Chicago, Ill.

Western Electric Company, Chicago, Ill.

Westinghouse Companies, Pittsburg, Pa.

William Wharton, Jr., & Company, Philadelphia, Pa.

Wheel Truing Brake-Shoe Company, Detroit, Mich.

Wilson Company, Chicago, Ill.

Yale & Towne Manufacturing Company, New York, N. Y.

Tramway Lines on the Continent.

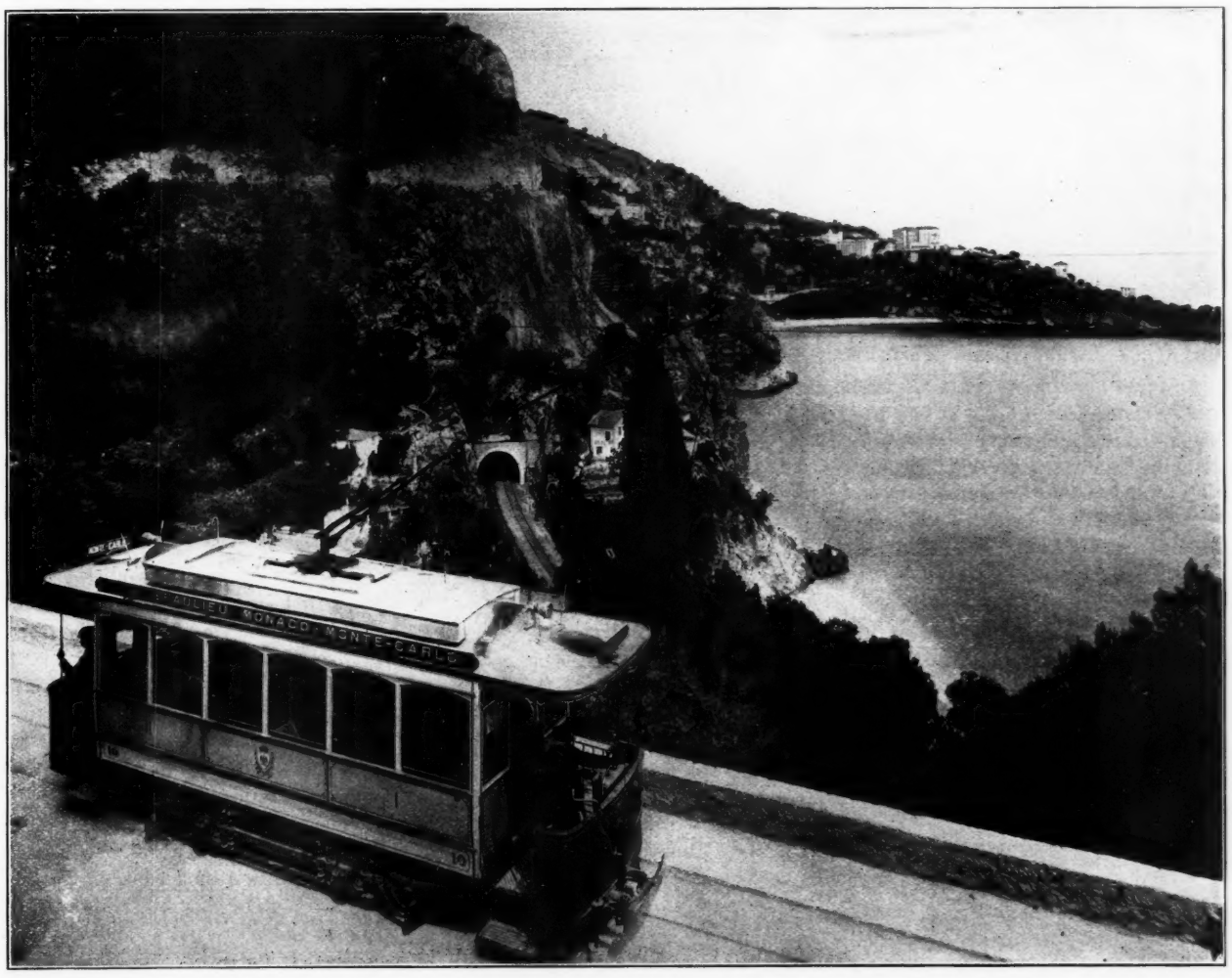
1. Mediterranean Coast Line. 2. Rouen Line. 3. Rome Tramways.

By C. L. Durand.

THE MEDITERRANEAN COAST LINE.

AN electric traction enterprise of considerable interest has been recently completed in the south of France, consisting of a series of tramway lines which are now in operation on the Mediterranean coast in the neighborhood of Nice and Monte Carlo. In addition to the traction lines of the different towns, the line which runs along the coast has now been finished over a long distance, and at present all the localities extending from Cagnes as far as Menton are connected by a continuous line thirty miles in length. The route along the coast, as will be observed in the views which are presented here, is one of the most picturesque on the Continent, and is often cut through the solid rock of the cliffs which overhang the sea. Starting from Cagnes, the coast line passes through Nice upon the tracks of the existing lines, then reaches Monaco and Monte Carlo and runs from thence to the terminus at Menton. This important system has been equipped by the Compagnie Française Thomson-Houston.

It is on the section from Nice to Monte Carlo that the most important part of the work was done in widening the route, as the latter passes along the shore where in many cases the cliffs overhang the sea. At a great number of points the cuts in the rock and the tunnels required to be widened out to accommodate the tracks, and the work also included the construction of embankments in masonry and bridges over the deep gorges of the mountain torrents. On this section the traffic is greatest during the winter season, and for this reason, outside of the through traffic from Nice and Monte Carlo, the traction company has organized services to the intermediate points, such as Montboron, Villefranche and Beaulieu. Thus, between Nice and Montboron the trains circulate at intervals of about three and one-half minutes. For this reason it was decided from the start to lay the road in double track from Nice to Villefranche, and as the work has been carried on very actively there is no doubt that at the present time nearly the whole of the line between Nice, Monte Carlo and Menton will be running double track. Over the whole of the coast lines the track is of Broca rail, about ninety-five pounds



MEDITERRANEAN COAST LINE—VIEW ON LINE BETWEEN NICE AND MONTE CARLO.

per yard, flush with the road surface, except between Monte Carlo and Menton, where there is a section about one mile long which is laid with Vignole rails placed upon ties.

The trolley line is placed in the centre of the track from Nice to Beaulieu and from Nice to Cagnes. For the rest of the line, that is, between Beaulieu and Menton, it lies to one side. This latter section includes the passage through Monaco. The line is supported on bracket poles over the whole distance.

The part of the road which passes from Nice to Cagnes first goes through the western suburbs of Nice, starting from the centre of town and following the city line for a certain distance, then proceeding along the coast it crosses the Var river and continues along the national route till it reaches the terminus at the railroad station of Cagnes. A depot has been established at Cagnes so as to allow the numerous small farmers of the region to utilize the tramway for transporting their products. Special trains for this purpose have been organized, so as to bring the fruits and vegetables into the market of Nice at an early hour of the day. The branch line of Contes is of interest on account of its freight traffic. This line passes up the Paillon river and is some ten miles long in all. On the route is situated the lime and cement works of the Société de Contes-les-Pins, which gives the tramway company an annual traffic of nearly 70,000 tons of freight, consisting of lime and cement. This freight is taken by the cars to the port of Nice for loading on the boats or the railroad, or in other cases it is brought by private branch lines into different storehouses in the city. The freight service of the tramway company is soon to have a large development, owing to an agreement which has been made between it and the Southern Railway Company, together with the Chamber of Commerce of Nice.

Outside of the coast line and the city lines of Nice, the Compagnie Thomson-Houston has also electrified the line which runs from Nice to Cimiez. This line starts from the centre of town and ends at the Zoological Gardens of Cimiez. In this case the gauge of the track has been increased from two feet to three feet (or the regular narrow gauge), and the trolley now replaces the storage battery system which was formerly used on the line, thus bringing this locality within fifteen minutes of the centre of town, in spite of the heavy grades which are found here. Since the electrification of the line, some of the finest hotels and villas have been erected upon the hill, and the traffic has become considerable upon this section.

The direct current at a mean tension of 550 volts which is needed for the lines belonging to the company is furnished by a certain number of substations placed along the road. They transform and convert the three-phase current at high tension, 10,000 volts and twenty-five cycles, coming from the Société Energie Electrique du Littoral Méditerranéen, which operates a number of hydraulic plants in the mountain region not far from the coast. At present six substations have been erected to supply the road. First, at Nice, at the Sainte Agathe depot, where is located the central transformer station, along with a steam plant and a large storage battery. Second, at Californie, midway between Nice and Cagnes. Third, at Beaulieu, midway between Nice and the western limit of Monaco, where there is also a transformer plant, along with a battery of accumulators. Another substation is located at Cap d'Ail, about a mile from the western boundary of Monaco, containing a bank of transformers. At upper Monte Carlo is located a generating station belonging to the Energie Electrique du Méditerranéen, where the transformers have been located. An extra feeder, about two miles in length, runs from this point to the last-mentioned substation, so as to replace the latter in case of need. The sixth substation is located at Cap Martin, between the east limit of Monaco and the terminus of the coast line at Menton. Here there is a bank of transformers and a battery of accumulators. A seventh station will soon be installed at Villefranche. The Sainte Agathe substation of Nice receives high-tension current from the hydraulic plant of Mescla, lying in the mountain region to the north of the city. Both the hydraulic station and the substation have already been described in detail in a preceding article. In 1902 a large battery of accumulators was added to the Sainte Agathe plant, which is designed to act as a reserve and also to work in parallel with the direct-current generators by means of a positive and negative booster. The battery is made up of 281 cells having a capacity of 1,030 ampere-hours at a one-hour discharge rate. The cell itself has been made of ample size, so that a greater number of plates can be used, and thus the capacity can be increased if need be to 1,300 ampere-hours at the same rate. A French firm, the Compagnie des Accumulateurs Union, supplied this battery. It is operated in connection with a booster group formed of a fifty-horse-power shunt motor coupled to a two-commutator machine of thirty-five kilowatts.

One of the Rock Tunnels on the Mediterranean Coast Line.

In the same plant, the two 150-kilowatt converters, which were designed for supplying the underground conduit line of Nice, are to be replaced by two motor-generator sets of 250 kilowatts, owing to the increase of traffic on this line. Each of these units is composed of a synchronous motor wound for 10,000 volts, direct-coupled to a 250-kilowatt generator which delivers direct current at 550 to 625 volts.

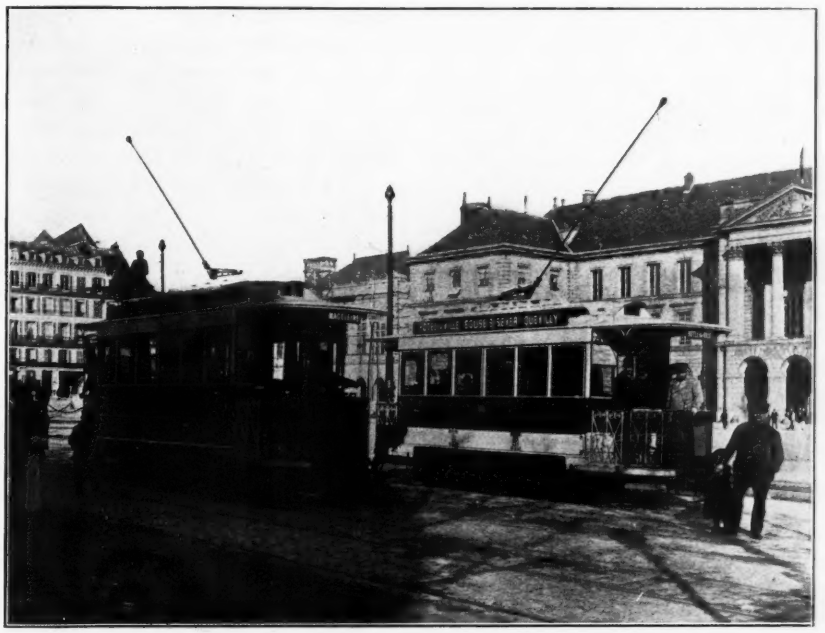
The substation at Beaulieu contained when first installed a bank of six transformers of the single-phase type, each of fifty-five kilowatts capacity and operating at fifty-five cycles. These transformers lowered the tension from 4,000 to 340 volts, and were used to supply two rotaries of 150 kilowatts, operating at 750 revolutions per minute, and delivering direct current at 550 volts on the average. Lately the substation has been increased by the addition of a bank of monophase transformers of fifty-five kilowatts, working at the above ratio, and also a new rotary converter of 150 kilowatts, with switchboard panels for the direct-current and alternating-current sides. There has also been added a storage battery composed of 275 cells having a capacity of 780 ampere-hours on a one-hour discharge, and the cells have space enough left so as to add plates to a total of 1,014 ampere-hours capacity. The battery is of the same type as above. With the storage cells is used a positive-negative booster like the group in the last-mentioned plant, con-

sisting of a direct-current 550-volt motor coupled to a generator with double commutator. There is also a three-phase transformer of 450 kilowatts capacity, operating at twenty-five cycles. This transformer is designed to be used as a reserve. Should an accident happen to the 5,000-volt cable which brings the working current into the station, the plant can use alternating current at 10,000 volts, coming from a high-tension line. In the usual practice, a bank of special transformers in the Sainte Agathe plant is used to lower the tension from 10,000 to 5,000 volts. Underground cables take the latter current from this plant to the substations of Beaulieu and Californie. This transformer has sufficient capacity to supply the three 150-kilowatt rotaries. It has an air-cooling system, using a motor-driven fan. A set of special switches allow of feeding either from the 10,000 or the 5,000-volt lines.

The substation which is located in the upper Monte Carlo plant gives a large supply of direct current. Part of it is sent over a feeder, two miles in length, to a smaller substation located on the coast at Cap d'Ail. The Monte Carlo outfit comprises six single-phase transformers of the oil-tank pattern, each delivering fifty-five kilowatts, and lowering the tension from 9,500 to 350 volts. The latter current is sent into the rotaries of 150 kilowatts operating at 500 revolutions per minute and converting to direct current at 500 to 550 volts. In addition to the above apparatus the plant contains a battery of 262 cells of accumulator of 410 ampere-hours at a one-hour rate, which is used with a booster designed to charge it. Only a part of the power of the Monte Carlo plant is taken for the regular traction line, and the remainder is used for a rack-and-pinion road which climbs the slope of La Turbie.

The drop in the feeder of 150 square millimetre section which connects the Monte Carlo plant with the substation at Cap d'Ail is made up by a booster set which has recently been erected here. This group is made up of a shunt-wound motor of seventy horse-power, operating at 700 revolutions per minute and delivering 500 volts, direct-coupled to a direct-current machine which is designed to furnish 350 amperes. A series winding is used upon the field of the generator which allows it to furnish 125 volts for an output of 300 amperes.

One of the principal substations of the line is located at Cap Martin. It comprises two groups of three static transformers with oil-tank, each giving fifty kilowatts, and two rotary groups of 150 kilowatts of the six-pole Thomson-Houston pattern, working at 500 revolutions per minute and delivering 500 to 550 volts direct current. These two rotaries are connected by a clutch to a countershaft provided with a pulley so that it can be belt-driven from a steam engine which acts as a reserve. The engine is of the horizontal, single-cylinder type, and is rated at 250 horse-power. A boiler plant has been installed in order to supply the engine, and it produces 5,000 pounds of steam per hour on the usual run. A special design of the rotaries which is used in this case allows them to be used either as converters for alternating current into direct current, as generators which are driven directly from the engine, in case the transmission line should fail to supply current. The plant is completed by a battery of accumulators composed of 265 cells of 320 ampere-hours on a one-hour rate. The battery can be run in parallel on the



ROUEN TRAMWAYS.

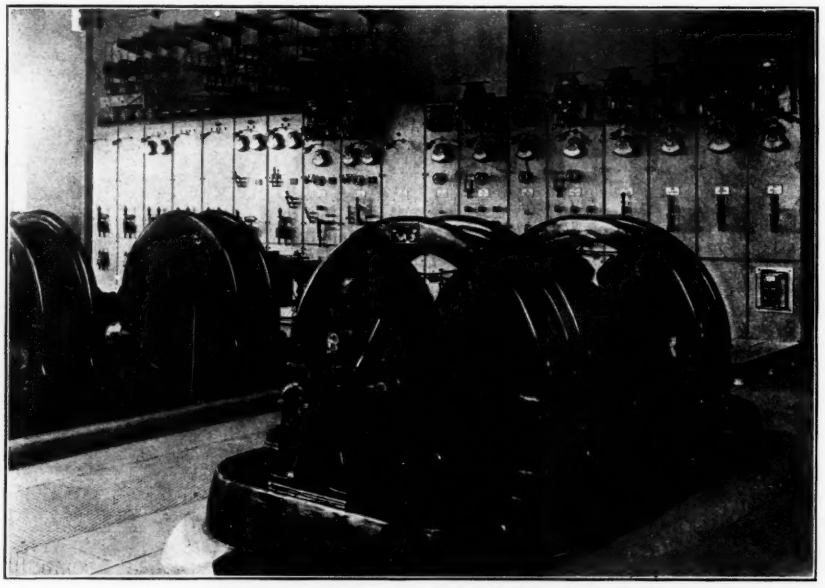
ROUEN TRAMWAYS.

direct-current line by the use of a positive-negative booster of fifteen kilowatts, consisting of a shunt motor running at 850 revolutions per minute and taking 500 volts, coupled to a double-commutator generator having a capacity of 175 amperes on each side. The drop in the feeder which supplies the Monaco-Cap Martin section is compensated by a booster which has been placed in the latter plant.

Not long ago the general council of the Maritime Alps department ceded to the Compagnie des Tramways a system of traction lines, part of which penetrates into the mountain region near the coast. These lines will be constructed at the expense of the department, and the tramway company is to furnish the electric outfit. The general council is now actively engaged with this question, and there is no doubt that operations upon the lines will be commenced in the near future. From the fact that the lines have a total length of nearly forty miles, it will be seen that the system will be of some importance for the region. The three lines which lie entirely within the mountain region are the Nice-Levens, the Menton-Sospel and the Pont de Peille-Escarène systems, while the remaining roads include the branch from the main line going to St. Jeau, the line along the coast from Cagnes to Antibes which will connect the Nice tramways with the Cannes traction system, and the road from Antibes to the Cap d'Antibes.

The completion of the coast lines made it necessary to provide a large outfit of cars, and there is now a large amount of rolling stock upon the lines. The Compagnie Thomson-Houston had already furnished 100 motor-cars, three freight locomotive cars and twenty-two freight trailers. Since the new part of the line has been finished, the following material has been supplied; six motor-cars of double-axle type and central platform, each of which is fitted with two motors, besides twenty trailers of the closed pattern, of which ten are equipped with air-brakes, allowing them to be attached to the preceding motor-cars, and ten equipped with electromagnetic brakes; also twenty-two trailers of the open-car type with cross seats, also using electromagnetic brakes. More recently the company supplied twenty motor-cars of a short type, mounted on two axles with the least distance between them, and designed to operate in pairs, with a single motorman. This solution has been adopted on account of the difficulty which is experienced in making the double-bogie cars of large capacity circulate upon the coast line, seeing that the roadway is narrow, and this does not allow of a sufficient spacing of the double track in the curves to enable the long cars to pass each other with ease. The outfit of the new cars includes two Thomson-Houston motors operating at seventy-three revolutions per minute and an outfit of series-multiple control apparatus. For passing upon the underground conduit lines at Nice, a plow outfit has been added to the cars. Besides the hand and air-brakes, the car is fitted with a safety hand brake which is worked from each platform. It acts upon each rail by means of a rubbing shoe with hard-wood surface.

At present the Sainte Agathe depot covers a large amount of ground in order to accommodate all the cars of the line. The repair shops have been installed in special buildings covering a surface of 2,000 square yards, and are well equipped for making all the needed repairs to the cars, including the winding of the motor coils.



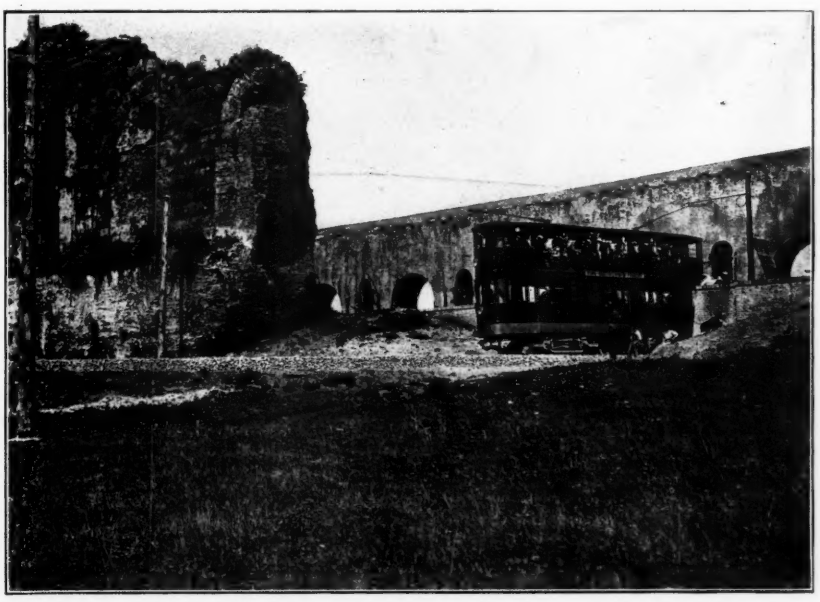
ROME PLANTS.—SUBSTATION, RECEIVING CURRENT FROM TIVOLI HYDRAULIC PLANT.

THE ROUEN LINE.

The city of Rouen contains a well-equipped system of tramway lines, controlled by the Compagnie des Tramways, which formerly operated an animal traction line of small importance, but when it was decided to electrify the existing lines and add a number of others the Rouen system took rank among the other lines in France, and at the present time it is one of the most important.

The old portion of the Rouen tramways comprises eight lines having a total length of sixteen miles, and to this was added a new portion to the extent of seven miles, making a total of twenty-three miles of road which was to be equipped with motor-cars. Thus it will be seen that the system needed a large outfit, both in the way of generating apparatus and in rolling stock. An entirely new track was laid for all these lines, and it is formed of Broca rail weighing ninety pounds per yard, with a five-foot gauge. The curves in the road are numerous, and on account of the narrow streets which are found in the old quarters of the town, they are often very short, and go down as low as a sixty-five-foot radius. An overhead trolley line is used, which is formed of hard-drawn copper of 8.25 millimetres. It is suspended axially above the tracks by steel cross-wires, and these are attached to iron poles, being well insulated from the latter. The poles are of the steel-tube pattern with four sections of decreasing diameter, and are some twenty-two feet high. Their lower part is provided with an ornamental cast-iron base of elegant design, while the joints of the tubes are covered with rings. The bronzing of the poles adds greatly to their appearance. On the quays of the Seine the poles are provided with a double bracket of the same type as is employed at Havre. Every other pole has an arc lamp mounted at the top in place of the usual metal ball, and this system of lighting has proved a great advantage in the handling of the cargoes on the wharves at night. On some of the main streets the poles are used to carry incandescent lamps, and owing to an agreement between the tramway company and the municipality,

the lamps are supplied with current by the Société Normande d'Electricité. The line has been installed with great care, so as to give it an attractive appearance as much as possible and thus overcome the usual objections to the overhead system.



ROME TRAMWAYS—ONE OF THE EXCURSION CARS ON THE SUBURBAN LINE.

The feeders which are used for the Rouen lines have a 200-square-millimetre section and a total length of 20,000 feet. They are well insulated with rubber and placed directly in trenches and are four in number, ending in different points of the town. The return cables are of bare wire of 150 square millimetres, placed in a wood conduit which is filled with asphalt. These cables end at the same points as the others just mentioned.

One of the illustrations shows the standard type of car which is used on the Rouen lines. This material has been furnished by the Thomson-Houston Company. This equipment consists of sixty cars of the double-platform type, with side entrance.

ROME TRAMWAYS—VIEW ON THE SUBURBAN LINE.

The interior of the car is divided into two compartments for first and second classes, separated by a sliding door. The cars contain twenty-four places in the interior and sixteen on the platforms. Each of the cars weighs about eight tons, and the total length is twenty-five feet or more. The trucks of the cars have been constructed in the Paris shops of the company, and are of a light and strong build. As regards the motor equipment of the cars, a slow-speed motor of the Thomson-Houston pattern is employed. The twenty-five horse-power motor is of the usual single-reduction ironclad type and weighs about 1,500 pounds.

Current for all the traction lines is furnished from a single station which has been erected for the purpose on the left bank of the Seine, not far from the river, where it has an advantage in the way of a coal and water supply. The station contains three main generating units of 300 kilowatts each, of the Thomson-Houston type. The boiler room is equipped with Babcock & Wilcox boilers and a Green economizer. An efficient condensing system is used in connection with the engines, and the condenser water is sent into a spray cooling apparatus, on the Sée system, by means of a pump. The latter is driven by a 500-volt motor.

Before the electric lines were installed, the Compagnie des Tramways of Rouen, who controlled the system, belonged to an English syndicate and operated a few animal traction lines. In order to change over and enlarge the system it was necessary to expend more than $1,000,000. As the company was unable to furnish this amount it was aided by the Compagnie Française Thomson-Houston. At the present time the electric tramways are in a flourishing condition and the tramway company is controlled entirely by French capital.

ROME TRAMWAYS.

Nearly all of the leading cities of Italy have adopted electric traction, and among these may be mentioned Florence, Milan, Palermo, Naples and others. The tramway lines which have been installed at Rome within recent years are now in successful operation. First were installed the lines which circulated in the outskirts of the city, and after these had been running for some time it was decided to lay the tracks so as to bring the cars to the central districts. The Societa Romana Tramways Omnibus has control of these lines and the electric equipment is supplied by the Compagnie Française Thomson-Houston, with material furnished from their Paris factories. Besides the lines which now circulate through the principal thoroughfares, several lines have been installed in order to connect the city with a number of suburban towns. One illustration shows a scene on the suburban roads, one of

which runs to Frascati and another to Albano and Genzano. These lines are largely used by tourists, who find it a great convenience to reach many of the historic localities in this way, with a great saving of time. The cars which are used on the suburban lines are of heavier build than the standard cars, and the latter have about the same general appearance as the cars last described for the Rouen lines. As to the suburban cars which run to Frascati and other localities, they are of the double-deck pattern, as will be observed, and have a large capacity in the interior and on the covered platform. The trolley system is used here as well as for the lines all over the city, and the trolley wire is supported from poles or from rosettes placed on the houses. The city lines are run in double track, and the grades are numerous, and some of them very steep when circulating among the seven historic hills of the city, and reach as high as 8.4 per cent. The curves are sometimes sharp as well, and sometimes they reach as low as seventy-five feet radius. For the rails, the Phœnix groove rail has been adopted on the lines within the city; this rail weighs seventy-two pounds per yard, and the gauge of the track is five feet. At each rail point the rails are connected by Chicago rail-bonds, and every 150 feet the two rails of a track are connected across by a seven-millimetre copper wire. Every 300 feet the four rails of the double track are joined in the same way, so as to make a good connection. This method has been found to work well in practice.

Current for the whole system of lines for the city of Rome is obtained at high tension from a hydraulic plant and transformed in a substation, which furnishes direct current and operates in connection with a storage battery. The high-tension current is supplied from the large hydraulic plant which has been erected within recent years at Tivoli, at a distance of eighteen miles from the city. Here the falls afford a supply which has been utilized by a large company, and a number of turbine units have already been installed in the plant. The city of Rome takes current from the Tivoli station for lighting and motors, exclusive of the traction lines, and the plant also furnishes current over the high-tension lines for different localities lying in this region. The alternator groups deliver 5,000 volts, which arrives at Rome at a tension of about 4,000 volts. One of the illustrations shows a view in the interior of the substation which has been erected to receive the high-tension line and to furnish the direct current for the tramways. The voltage of 4,000 is first lowered to 2,000 by a bank of transformers. Rotary groups receive this current and convert it into 500 volts. These groups, which consist of two four-pole machines coupled together and mounted on the same foundation plate, will be observed here. At present the substation contains three similar groups, and the capacity of each is eighty kilowatts. In the station is mounted a large battery of accumulators, which are connected in parallel upon the main bars of the 500-volt circuit. During a great part of the day the batteries act as an equalizer to take up the shocks of the line, but for two or three hours of the evening they are used to operate the part of the traction system by a direct connection upon the lines. A switchboard of eighteen white marble panels completes the outfit of the substation.

FREQUENCY METERS.[1]

BY F. CONRAD.

In the commercial measurements of electrical quantities, that of current is the only one in which the measurement is directly referred to the quantity in question. In an ammeter the effect produced by the current is directly the means of indication. For measurement of potential it is necessary to refer to the current which will flow in a circuit of known resistance. A possible exception to this may be found in the "spark-gap" method of potential measurements. In the measurement of frequency we are dealing with the cyclic changes of another quantity, that of potential, and, as usually the changes occur too rapidly to be observed directly by a potential measuring device, it is also necessary to resort here to an indirect method of observation.

Instruments now in commercial use operate on one or the other of the following principles, namely, the sensitiveness of a vibrating reed to respond to an operating force of the same frequency only, and the change in impedance produced in inductive circuits by change of frequency.

Instruments of the first type usually consist of a number of steel reeds tuned to various pitches over a certain range of vibration. The reeds are placed within the attractive influence of a magnet which is energized by a potential, the frequency of which it is desired to obtain. The general construction of an instrument of this type is comparatively simple, as it has no moving parts on pivots or bearings. To obtain the best results it is necessary that the potential be maintained at a value which does not differ greatly from that for which the instrument has been designed, as with too low a value the amplitude of vibrations will not be sufficient to be readily observed. With too high a value a number of reeds differing in pitch from that of the circuit may start into vibration with varying amplitude as they come into and out of synchronism with the magnetic field. In view of this, and from the fact that at the best the readings are largely a matter of estimation, this type of meter has not come into very extended use in this country.

A simple instrument of the second type would consist of an ammeter connected in circuit with an impedance of known value and across a circuit of known potential. From the current reading obtained and the known value of potential and impedance, the frequency may be obtained by calculation. To make the instrument direct reading it would be necessary to maintain the potential at some fixed value or to introduce some compensating device in the instrument, the latter principle being the one employed in most instruments now in commercial use.

The construction in general consists of an operating element in series with an inductive resistance and a retarding or compensating element in series with a non-inductive resistance. No controlling spring is used, the retarding element taking its place. If the torque of the operating and retarding element varies in the same ratio with changes of voltage, the instrument will give indications which are independent of changes of voltage.

The chief causes which would produce variation of reading with change of voltage are:

1. Increase of non-inductive resistance due to heating on high voltages.

2. Change of permeability of iron in inductive resistance with change of current.

3. Dissimilarity of ratio between torque and voltage of operating and retarding elements.

The first may be minimized by keeping the heating effect of the current low and using a wire of low temperature coefficient. The second will always be present to a greater or less extent, but it may be corrected by combining it with the third in such a proportion that the two will cancel out.

The general construction of the instrument may be such that it will harmonize in appearance and method of reading with that of other instruments which may be used in the same installation, and from the manufacturers' standpoint it possesses the advantage of using parts which are interchangeable with other instruments such as voltmeters and ammeters.

[1] *Electric Journal*, September.

THE EFFECT OF IRON IN DISTORTING ALTERNATING-CURRENT WAVE-FORM.[1]

BY FREDERICK BEDELL AND ELBERT B. TUTTLE.

(Concluded.)

RELATION BETWEEN AREA OF HYSTERESIS LOOP AND ANGLE OF HYSTERETIC ADVANCE.

Since only the fundamental in the current wave represents power, and the harmonics are wattless, we have the same power represented by the fundamental as by the complex wave. Hence if values of H be taken from the fundamental current curve, and a hysteresis loop plotted, it will have the same area as though H were taken from the complex wave, as was done in deriving the loops in Figs. 14 and 15. In this case, however, with H as well as B sinusoidal, the hysteresis loop would form an ellipse, the area of which can be shown[2] to be

$$A = \pi XY \sin \psi.$$

Here X and Y represent the maximum values of the sinusoidal magnetizing force H and induction B, respectively.

As has just been shown, the area of this ellipse can likewise be taken as the area of the loop when the complex wave current is taken. It at once follows that

$$\sin \psi = \frac{A}{\pi X Y} = \frac{1}{\pi} \cdot \frac{A}{X' Y} \cdot \frac{X'}{Y} = \frac{1}{\pi} \cdot \frac{A}{X' Y} \cdot \frac{I'}{F}.$$

Here F is the maximum value of the fundamental and I′ the maximum value of the complex current wave; X and X′ being corresponding values of magnetizing force. X′ Y is the area of the rectangle enclosing the hysteresis loop.

For $\frac{A}{X' Y}$ write ρ; and for $\frac{I'}{F}$ write f.

For any hysteresis loop the value of the hysteretic advance may then be derived from the following expression:

$$\text{Sin } \psi = \rho \, f/\pi,$$

where ρ is the ratio of the area of the hysteresis loop to the enclosing rectangle, and f is a form-factor—the ratio of the maximum values of the complex and fundamental current waves. If the result depended upon ρ only, hysteretic advance could be readily and directly determined from area of the hysteresis loop. The results are modified, however, by the presence of f, which is unsatisfactory, for it makes the direct determination in this way impossible. Table II gives values of I′ for curves 5-13.

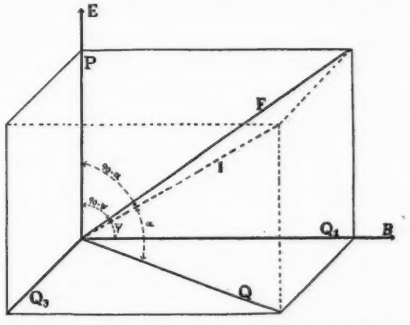


FIG. 16.—VECTOR REPRESENTATION IN THREE DIMENSIONS OF A COMPLEX CURRENT. E IS SINE ELECTROMOTIVE FORCE; F IS FUNDAMENTAL CURRENT; Q_3 REPRESENTS HARMONICS; AND I IS THE EQUIVALENT SINE CURRENT.

VECTOR REPRESENTATION OF COMPLEX CURRENT.

Without iron, where current as well as electromotive force is sinusoidal, as shown in Fig. 1, the vector representation of these quantities as lines in a plane is well known.

Let us take, however, such a case as shown in Fig. 2, in which the electromotive force E is sinusoidal and the current

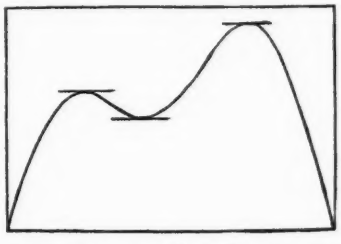


FIG. 17.—TWO CRESTS, ONE TROUGH AND TWO INFLEXIONS.

I, on account of iron, is complex, being composed of a fundamental F and third harmonic Q_3.

Considering first the fundamental F, this may be considered as composed of two components, Fig. 16, a power component P in phase with E, and a quadrature or wattless component Q_1 at right angles to E; that is, $F = \sqrt{P^2 + Q_1^2}$. These quantities E, F, P, and Q_1 are all sine functions of the same frequency and are graphically represented in one plane. The induction B is in the direction of Q_1, and is also a sine function of fundamental frequency. The fundamental F lags behind E by an angle $90 - \psi$ (as in Fig. 2); ψ is the angle between Q_1 (or B) and F. In Fig. 16 and its discussion all quantities represent virtual or square root of mean square values.

The harmonic Q_3 has no power component in phase with E; it is entirely wattless, as has been shown, and hence is to be represented graphically in quadrature to E. But it may be shown[1] that $I = \sqrt{F^2 + Q_3^2}$, which corresponds to a graphical construction in which Q_3 and F are two sides of a rectangle and I the diagonal. As Q_3 is thus at right angles to both E and F, it is drawn in the third dimension at right angles to the plane of fundamental frequency in which lie E, F, P, and Q_1.

The total current is I, the diagonal of the rectangular parallelopiped. I is the equivalent sine wave representing the complex current. In phase it is as represented in Fig. 16, lagging behind F by an angle $90 - a$. In magnitude it is such as to have the same square root of mean square value as the complex wave. We have seen that

$$I = \sqrt{F^2 + Q_3^2};$$

We also have

$$I = \sqrt{P^2 + Q_1^2 + Q_3^2}.$$

In the usual treatment confined to one plane, the plane taken is the diagonal one in which lie E and I. The equivalent sine current I may be resolved into a power component P of fundamental frequency in phase with E, and an equivalent wattless component Q at right angles to E. The component Q is itself complex, consisting of two components each wattless; namely, Q_1 of fundamental frequency and the harmonic Q_3. We have then

$$Q = \sqrt{Q_1^2 + Q_3^2},$$

and

$$I = \sqrt{P^2 + Q^2}.$$

Power is the product of E and P. Considering the fundamental sine curve, we have for power in terms of F:

$$W = E F \cos (90 - \psi).$$

If we consider the equivalent sine curve, we have for power in terms of *I*:

$$W = E I \cos (90 - a).$$

Each is correct, the two expressions being practically identical. An error (numerically small) would be made by confusing the fundamental and equivalent sine curves, and interchanging the values of

[1] A paper presented at the two hundred and ninth meeting of the American Institute of Electrical Engineers, New York, September 28, 1906. For first part see ELECTRICAL REVIEW, October 6.

[2] Let the induction and magnetizing force be respectively $y = Y \sin \omega t$ and $x = X \sin (\omega t - \psi)$. Plotted in rectangular coördinates, the resulting figure will be an ellipse. Its area (see translation of Goursat's Mathematical Analysis, p. 185) will be

$$A = \tfrac{1}{2} \int_0^{2\pi} (x \, dy - y \, dx).$$

$$= \int_0^{2\pi} \tfrac{XY}{2} \{ \sin \omega t \cos(\omega t - \psi) - \sin (\omega t - \psi) \cos \omega t \} \omega \, dt$$

$$= \frac{XY}{2} \int_0^{2\pi} (\sin^2 \omega t \sin \psi + \sin \psi \cos^2 \omega t) \, \omega \, dt$$

$$= \pi X Y \sin \psi.$$

[1] This is independent of the phase position θ of the harmonic. See F. Bedell, "The Principles of the Transformer," p. 391.

F and I, or of ψ and a. It is seen that

$$\frac{\sin a}{\sin \psi} = \frac{F}{I} = \frac{F}{\sqrt{F^2 + Q_3^2}}.$$

For the curves in Figs. 5-13, the values for a and ψ are given in Table II; also I, the maximum value of the equivalent sine wave. In constructing the curves, F has been taken as unity; then $Q_3 = \beta$ (see table).

The graphical construction of Fig. 16 will include the representation of higher harmonics if we include them all in Q_3; that is, in place of Q_3, we should have $Q_x = \sqrt{Q_3^2 + Q_5 \ldots Q_n^2}$. Separately and collectively the harmonics are wattless, and are at right angles to both E and F. Their separate representation in three dimensions is not possible; for, in addition to being at right angles to E and F, each one should be at right angles to each other one, requiring an additional dimension for each harmonic above the third. This representation is, however, unnecessary, for, since all are wattless,

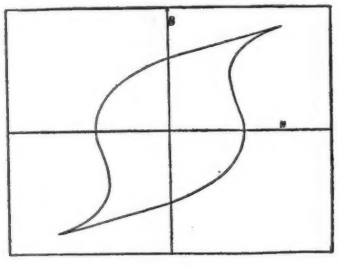


FIG. 18.—HYSTERESIS LOOP CORRESPONDING TO FIG. 17, WITH FOUR MAXIMA FOR H WHICH WOULD RESULT WERE THE LIMITS OF β GIVEN IN FIG. 4 EXCEEDED.

their collective representation as one line, Q_3, meets all requirements.

If we are to represent all quantities in one plane only, the vector representation is correct for each frequency, and for the equivalent sine curve separately; components of different frequencies so drawn are not to be combined vectorially, but are to be added by taking the square root of the sum of the separate squares.

CONCLUSION.

We conclude that an alternating current is distorted when iron is present by the introduction of a third harmonic in advance of the fundamental by an angle θ which is greater than 30° and less than 180°.

Taking the fundamental as unity, this harmonic can not exceed a definite value (see Table I) of about 0.192 for $\theta = 30°$, and 0.333 for $\theta = 180°$.

The angle ψ of hysteretic advance due to the third harmonic can not exceed 30°.

From the shape of the hysteresis loop obtained from the third harmonic only, it is concluded that iron introduces higher harmonics in addition to the third.

Three dimensions, as Fig. 16, are required for the vector representation of the complex current wave.

APPENDIX.[1]

RELATION BETWEEN θ AND β.

We wish to find the condition which holds at the transition state, Fig. 19, separating the impossible case of two

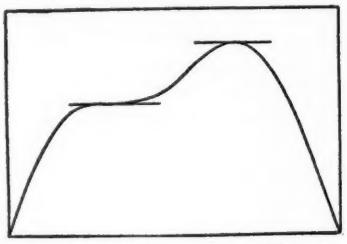


FIG. 19.—ONE CREST AND ONE HORIZONTAL INFLEXION.

maxima and one minimum, Fig. 17, and the possible case of one maximum and no minimum, Fig. 20. The form of hysteresis loop, Fig. 18, corresponding to Fig. 17, shows the impossibility of the former case.

We proceed to find the condition imposed upon θ and β so that the graph of $f(t) = \sin \omega t + \beta \sin (3 \omega t + \theta)$ shall have no trough or minimum in the first half cycle.

By differentiation we have

$$f'(t) = \omega [\cos \omega t + 3 \beta \cos (3 \omega t + \theta)] = 0,$$

hence the positions of the crests and troughs are given by the equation

$$\cos \omega t + 3 \beta \cos (3 \omega t + \theta) = 0.$$

We shall find the condition that this equation may have two roots equal; and, subject to this condition, we shall find

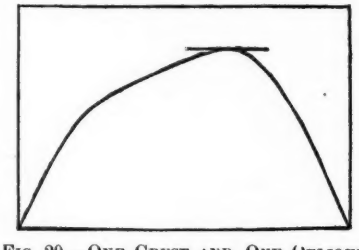


FIG. 20.—ONE CREST AND ONE OBLIQUE INFLEXION.

the next root; this will give the position of the only proper crest or maximum in the first half-cycle.

For convenience let $9 \beta = 1/a$ and write x for ωt.

Then

$$\cos (3 x + \theta) + 3 a \cos x = 0.$$

That is

$$\cos 3 x \cos \theta - \sin 3 x \sin \theta + 3 a \cos x = 0.$$

Therefore

$$(4 \cos^3 x - 3 \cos x) \cos \theta - (3 \sin x - 4 \sin^3 x) \sin \theta + 3 a \cos x = 0.$$

Dividing through by $\cos^3 x$ we have

$$(4 - 3 \sec^2 x) \cos \theta - (3 \tan x \sec^2 x - 4 \tan^3 x) \sin \theta + 3 a \sec^2 x = 0.$$

Replacing $\sec^2 x$ by $1 + \tan^2 x$ we get the following cubic for $\tan x$:

$$\sin \theta \tan^3 x + 3 (a - \cos \theta) \tan^2 x - 3 \sin \theta \tan x + (3 a + \cos \theta) = 0.$$

Now it is known in the theory of equation that the cubic (1)

$$a x^3 + 3 b x^2 + 3 c x + d = 0$$

has two equal roots when

$$4 (a c - b^2) (b d - c^2) = (a d - b c)^2,$$

the equal roots being given by

$$x_1 = x_2 = \frac{b c - a d}{2 (a c - b^2)}$$

and the third root by

$$x_3 = -\frac{3b}{a} - \frac{b c - a d}{a c - b^2}$$

For our cubic the condition for equal roots becomes

$$-4 (a^2 - 2 a \cos \theta + 1) (3 a^2 - 2 a \cos \theta - 1) = (4 a \sin \theta)^2,$$

whence

$$\cos \theta = \frac{3 a^4 + 6 a^2 - 1}{8 a^3}; \quad (2)$$

and the expressions for the roots become

$$\tan x_1 = \tan x_2 = \frac{2a \sin \theta}{a^2 - 2a \cos \theta + 1}, \quad (3)$$

$$\tan x_3 = \frac{-3 (a - \cos \theta)}{\sin \theta} - \frac{4 a \sin \theta}{a^2 - 2 a \cos \theta + 1}. \quad (4)$$

With the aid of (2), the last expression reduces to

$$\tan x_3 = -\frac{(1 - a^2) (1 + 3 a^2)}{8 a^3 \sin \theta}.$$

It is convenient to let $\frac{1}{a} = b$, then $b = 9 \beta$, and

$$\tan x_3 = -\frac{(b^2 - 1) (b^2 + 3)}{8 b \sin \theta}, \quad (5)$$

wherein θ is given by (2), or by

$$\cos \theta = \frac{3 + 6 b^2 - b^4}{8 b}, \quad (6)$$

or (in a form better adapted to logarithmic computation) by

$$\sin \theta = \frac{(b^2 - 1)^{\frac{3}{2}} (9 - b^2)}{8 b}. \quad (7)$$

This equation, wherein $b = 9 \beta$, gives the desired relation between θ and β. If we assume a given value of θ and solve for β, the value so obtained would be the greatest value of β that could be used with the given value of θ without obtain-

[1] Due to Professor James McMahon.

ing a trough as in Fig. 17, which corresponds to the impossible hysteresis loop of Fig. 18.

To determine ψ, the phase displacement of the crest, we proceed as follows:

Eliminating sin θ from (5) by means of (7) we obtain

$$\tan x_3 = -\frac{b^2 + 3}{\sqrt{(b^2 - 1)\ (9 - b^2)}}. \quad (8)$$

Hence the position of the crest is given by

$$\omega t = \pi - \tan^{-1} \frac{b^2 + 3}{\sqrt{(b^2 - 1)\ (9 - b^2)}} \quad (9)$$

Now the crest of the fundamental curve ($y = \sin \omega t$) is given by $\omega t^1 = \frac{\pi}{2}$. Hence the displacement of the crest due to the presence of the third harmonic is given by

$$\psi = \omega (t - t_1) = \frac{\pi}{2} - \tan^{-1} \frac{b^2 + 3}{\sqrt{(b^2 - 1)\ (9 - b^2)}}, \quad 10$$

wherein $b = 9\ \beta$. This gives ψ in terms of β, when θ is determined as in (7).

Since neither (7) nor (10) is readily solvable for b, it is best to assign values to b and compute corresponding values for θ and ψ. Equation (7) shows that b can not be less than 1 nor greater than 3; and equation (6) shows that $b = 1$ corresponds to $\theta = 0$, and $b = 3$ to $\theta = \pi$. Table I gives values of θ and ψ computed from (7) and (10), by letting b run from 1 to 3 at convenient intervals, not always equi-distant. The corresponding values of β run from 0.111 to 0.333.

Dedication of the New Building for the Engineering Departments of the University of Pennsylvania.

Exercises dedicatory of the new building for the engineering departments of the University of Pennsylvania will be held on Friday, October 19. The building is located at Locust and Thirty-third streets, West Philadelphia, and will be open for private view from 9 A. M. to 5 P. M. Luncheon will be served at 12.30 o'clock. The building will be open for public inspection on October 20.

Traction Managers' and Auditors' Association.

The annual meeting of the Traction Managers' and Auditors' Association was held in Syracuse, N. Y., October 4. The association was formed last December, and already has exerted considerable influence upon public service in several large cities. The meeting was well attended by representatives of traction interests in the state.

THE TESTING OF COAL.[1]

BY A. BEMENT.

The purchase of coal under specification stipulating its composition, and the analysis of the fuel delivered under such specification, has now become an important feature of the coal business, and while the practice is of comparatively recent origin in this general locality, experience has demonstrated that there are certain features of specifications and analytical methods which may be corrected and improved. This applies particularly to the business transactions between the dealer who sells the coal and the purchaser who burns it. Another phase of the problem concerns the work being done at the coal-testing plant of the United States Geological Survey at St. Louis, the Illinois Geological Survey and the Engineering Experiment Station, of the University of Illinois. The work of these institutions may be considered as that of research, to distinguish it from the inspection service.

It is the principal object of this paper to emphasize the necessity for improving the practice governing specifications and inspection, and also to suggest certain lines along which the research work should proceed, and it is fuel coal from the eastern interior coal basin that is more particularly considered.

The improvements and corrections which concern terms of specifications, and the inspection service, require that determinations of the following be abandoned:

Moisture,
Volatile matter,
Fixed carbon,
Sulphur,
Evaporative power of the coal.

Every essential requirement of the purchaser may be fulfilled by confining specifications and tests to the three following characteristics; in fact, these three features alone will insure greater protection to the purchaser than obtainable under present general practice:

Per cent of ash in the dry coal,
Size of the coal,
Heating power of the pure coal.

The latter, according to prevailing practice, would preferably, of course, be expressed in British thermal units.

The reasons for the above recommendations are given under the following captions:

MOISTURE.

Moisture is a great and uncertain variable. It not only differs in various coal seams as the coal lies in the ground, but is affected in fuel as received in shipment, by conditions of weather, temperature and time the coal may be in transit. It is approximately correct, however, to say that each coal seam has a characteristic moisture content of its own, which is uniform over at least very considerable areas, but the after influences above mentioned change it, so that there is no assurance of what it may be except under specially defined conditions.

Therefore, the producer or coal dealer can exercise no control over moisture, and as the prime object of fuel inspection service is to insure that the customer is served to the best ability of the dealer, specifications and tests of moisture in coal delivered can offer no protection to the purchaser. As before mentioned moisture varies in different coal seams; for this reason it might appear that its determination would indicate the seam from which the coal came. This is not true, however, for reasons above mentioned. If tests are expected to identify the seam which produced the coal other means must necessarily be employed.

However, in coal inspection service, moisture has been found to be very high in cases where delivery is by wagon, which, owing to lack of sufficient explanation of phenomena at the time, may have led to the opinion that the dealer wetted the coal for the purpose of increasing its weight at the time of loading. If this is the practice, it necessarily complicates the problem, but the writer has had cause to visit every coal yard in Chicago, and never observed any wetting of coal or any appliances for such purpose. It would be a difficult and expensive matter to wet fuel as loaded, and require water pipes located along team tracks, which in some cases extend for several hundred feet, and with the finer sizes of coal it would necessitafe a man stationed at each wagon to supply water as fast as the coal was loaded, otherwise it would be impossible to add any great amount, because simply flooding the top of a wagon-load of screenings, for example, would only insure the upper surface being wetted as the water would not penetrate the mass. A further study of this matter has made it appear to the author, that this high moisture in wagon-delivered coal is due to the practice of wetting coal while it is being unloaded, very often done for the purpose of allaying dust, and to the water which is commonly added in the fire room for various

[1] A paper presented to the Western Society of Engineers, Chicago, Ill., October 3.

reasons, both prior to the time of sampling.

This matter of moisture also complicates the problem as far as the inspection service is concerned, because it is impracticable for the inspecting company to have its sampler present when a wagon-load of coal arrives, as it would entail an expense which the service could not bear. Also, sampling attempted at the time of unloading could not be properly performed, as the sampler would be unable to gather from a wagon at the sidewalk and prepare a sample as it should be done. Thus it appears, that the determination of moisture, even in wagon-delivered coal, serves no useful purpose. With fuel received in cars, there could, of course, be no opportunity for adding water.

VOLATILE MATTER.

No fuel coal of this locality is purchased for the purpose of making gas or for use in byproduct recovery plants, therefore tests for this constituent are unnecessary, unless there be a great difference in the coal. "Volatile matter" is not very well understood. The best conclusion is that coal is a complicated hydrocarbon which breaks down in distillation into various fractions, depending upon temperature and duration of heating period, and that the difference in coal of this basin is not greater than that due to the varying effect produced by the volatilization test itself; or, in other words, the variation may be caused by the test rather than by the composition of the coal. Thus the volatile matter test is not sufficiently accurate to be of service in this case. It is, of course, true, that it would distinguish between bituminous, semi-bituminous and anthracite coal, but one may do this merely by inspection without any test whatever.

All coal of this basin is high in "volatile matter"; all will make smoke if burned in sufficiently bad furnaces, and all will make smokeless combustion and good efficiency in good furnaces.

FIXED CARBON.

In coal analysis the disposition is to follow precedent. Coal mining became an important industry in the East long before it did in this locality. Much coal in the Appalachian basin is suited to the manufacture of a high grade of coke, and the amount of residue, or, in other words, the coke obtained under the conditions of the process, is a matter of first importance. This has had the effect of emphasizing the importance of "fixed carbon," so that it has been looked upon in many quarters as of more moment than any other characteristic of coal, and these ideas, extending to our locality, have to a considerable extent influenced opinion regarding fuel. The same remarks regarding the uncertainty of the determination of volatile matter apply to that of fixed carbon, because the test for the former is the one giving data for the latter. If coke was made from coal of this locality, it would be possible under certain conditions, to make a useful application of the test for fixed carbon; inasmuch, however, as it is not the case, this constituent is only a troublesome and misleading feature of analysis.

SULPHUR.

Sulphur has been in a measure treated in the past the same as fixed carbon. In metallurgical work it is of extreme importance, and in this connection has received more attention than with fuel coal. This has given a prominence to the sulphur determination which it would not otherwise possess, and upon the assumption that sulphur is in the form of pyrites or very largely so, the conclusion has been accepted that the amount of sulphur is an indication of the tendency of the ash in the coal to clinker. This is true, however, to only a slight extent; in fact, may not even be considered as a working hypothesis in this coal basin, because some of the seams which are the highest in sulphur produce the least clinkering, therefore conclusions regarding the behavior of the ash in this respect are not justified by the amount of sulphur in the coal.

EVAPORATIVE POWER.

This is something which should never, under any circumstances, become a feature of specifications or guarantees, for several very important reasons. In general, too many variable factors enter into the problem. For example, boilers differ, some being more efficient than others, absorbing greater or less amounts of heat from the coal for reasons due to their individual superiority or inferiority. Then furnaces differ greatly; in some cases all of the volatile matter may be burned; in others, a large portion be wasted. Again, fire grates differ in like measure, causing varying losses of fuel which falls into the ash pits, and the combination of grate and furnace has an important influence on the excess of air which necessarily enters, and for this latter reason, also, the useful result obtained from the coal is affected to a marked extent. The above refers to the characteristics of the apparatus itself, but at this point another and most serious variable must be considered, that of the personal equation of the fireman or furnace operator; therefore it is apparent that in such a test, one may be unable to discover whether the result is due to the fuel, the peculiarities of the apparatus or its manipulation. In the case of a coal purchaser who does not realize these facts, the result is always attributed to the object in view, which is, in such instance, to determine the value of the coal. If he had wished to discover whether he employed a good fireman or not, the experiment would have been precisely the same, and he would have then considered the result due to manipulation. It is not only the above features which have an important influence, but the character of the load on the plant is a matter of great moment. In a works where boilers run steadily for twenty-four hours, the result secured, everything being equal, will be much better than in one where the work is necessarily interrupted by stoppages at noontime, shutting down at night, or with peaks of load as in electric railway service. Any one of the foregoing causes may exercise a greater influence on the evaporative result secured than that due to variation in fuel.

It is not intended in the above to imply that coal-burning experiments are not useful, because there are some things which may be settled as affecting certain plants; for example, fuel high in ash generally costs less per ton than that containing less ash, and it might be a question which would be the most economical to use; or, the matter of the most desirable size of fuel may be in question. These two are the only features which can be settled by burning coal under a boiler, and they should not be made part of a specification or guarantee, but used entirely for the guidance of the fuel user in selecting the best grade.

The behavior of coal under boilers is a problem very little understood, because it is the result of many variable influences, and for this reason it is often felt that the calorimetric test is unreliable, which, however, is not true, because the calorimeter does its work very accurately as far as the coal itself is concerned; its efficient utilization in service is influenced only by the amount and fusibility of the ash associated with it and the size of the pieces of the fuel. This matter has been extensively treated elsewhere.[1]

It is well in this connection to direct attention to the fact that there is a feeling more or less prevalent, that coal from different localities or seams may possess some undefinable peculiarity in its chem-

[1] See Mr. Abbott's paper, presented September 5, 1906

ical combination, which causes it to behave differently under a boiler than it would in a calorimeter. Such conclusion is untenable, because the process is identical in each case, that of combination of oxygen with the carbon, hydrogen and sulphur of the coal, and this combination can not be any different under the boiler than in the calorimeter, unless certain influences due to the peculiarity of the boiler apparatus and its manipulation assert themselves, and it is the disposition as far as the coal is concerned, to blame it for effects which are due to causes other than its chemical composition. It is well in this connection to call attention to the fact that the heating power of the coal proper, or in other words, the pure coal in Illinois, only ranges from 14,000 as a minimum, to 14,750 British thermal units as a maximum, and that about eighty per cent of the fuel produced ranges between 14,000 and 14,500 British thermal units per pound. Thus the enormous variation found in service under boilers as far as the amount of water evaporated per pound of coal is concerned, is mostly due to the characteristics of the apparatus, its manipulation, and to the size of the coal and the amount of ash associated with it.

Thus it is very clear that specifications or guarantees covering amount of evaporation per pound of fuel or per cent efficiency, are not only useless but troublesome to the purchaser and dealer.

The three approved tests may now be considered, and while in the above classification they are presented in the order of greatest importance, it will be convenient to change their arrangement.

PURE COAL.

For better understanding, it is desirable to consider coal as the chemical combination of certain elements which are principally heat producing. The association of ash and moisture with these result in an aggregation which may be designated as fuel, although generally called coal, which, from this standpoint, however, is not correct, because neither ash nor moisture produces heat.[1] The expression, pure coal, is the equivalent of what has erroneously been called combustible, the pure coal containing all of the combustible matter, and some water of composition and nitrogen which are not combustible, but as these two ingredients are associated chemically with the combustible the ultimate conception of coal is covered by this term, pure coal. Thus in the heating power determination, it is more to the point to base results on the pure coal than on any of the fuel mixtures, illustrated as follows: Let it be assumed that in one case the British thermal units per pound of dry coal is 13,250, and in another 12,450, from which it would appear that the two lots of fuel were different, but if the percentage of ash content in each is known, and the first sample contained seven per cent and the latter twelve per cent, it appears that each sample has a pure British thermal unit of 14,250, or, in other words, that the coal is the same in each, there simply being more ash associated with it in one case than the other. Basing the heating power determination on pure coal has another very important advantage, as it enables one to judge of the accuracy of analysis, because when the heating power and the source from which the coal comes is known, there is evidence indicating whether or not the analysis has been correctly performed, because, if it has not been, it will be shown by the British thermal unit.

[1] Journal American Chemical Society, vol. xxviii, page 632.

ASH.

An important reason why ash should always be considered as a percentage of the dry coal instead of the moist fuel is, that like the British thermal unit determination, unless it is placed on some common basis, proper comparison can not be made on different lots of fuel; for example, in two samples, the moisture may be eight and thirteen per cent, and ash in the dry coal ten per cent in each, but expressed on the moist coal basis, it appears that one has 8.7 and the other 9.2 per cent of ash, and it would seem that one of the fuels contained more than the other. In this connection the fact should be borne in mind, that no one burns moist coal; the moisture is evaporated and passes away; in fact, dry coal is not burned, the ash remaining; it being the pure coal which enters into the process of making fire.

SIZE OF COAL.

As a general proposition, the value of fuel increases with the size of the pieces, so that a very fine "duff" is of little use, but as the pieces become larger, the actual value increases in a greater ratio than does the heating power, and this continues to egg size and lump. Thus smaller pieces containing the same amount of heat per pound as larger ones, are of less value than the larger coal.[1]

The size of the pieces of coal exercises an important influence not only on the capacity which may be produced by a boiler, but on the resulting efficiency, and the best size to be used in a given case is dependent upon many conditions, such as the strength of draught, kind of stoker or grates, method of firing, etc., and the selection of the proper size of fuel or the method of utilizing the available size often affords an opportunity to effect important economies.

[1] See Mr. Abbott's paper, presented September 5, 1906.

SAMPLING.

One feature of the matter, referring especially to coal inspection service, is proper and reliable sampling. In very many cases the coal inspection service is rendered by a company, which, while acting as the purchaser's representative, is depended upon to furnish the seller with reliable reports concerning the composition of coal supplied. Under such conditions, it is absolutely necessary that not only shall the inspecting chemist be both competent and reliable, but that he shall be as fully responsible for the collection of the samples as he is for the analytical report, and it is also absolutely essential that the purchaser or his employés shall not be allowed to sample any coal or assist in the sampling, because under such conditions, the chemist may not know whether the report which he makes is correct or not, and it is well to emphasize the fact that the sampling is of as great importance as the analysis itself.

Referring to the branch of the subject before mentioned as that of research, there has been in operation for some years at St. Louis, what has been designated as a fuel-testing plant, under the direction of the United States Geological Survey. Its principal published work so far, however, has been largely confined to "tests" under boilers, which have been thought to show the "real steaming value" of the fuel. The author's remarks above regarding testing coal under boilers will refer to this branch of the work.

Probably the reference to coal in the plural has done much to cause confusion, because it has led people to believe that there are very many "kinds" of coal. For example, fuel from Herrin and Carterville in this state would, according to this, be considered as different "coals," when, as a matter of fact, they are from the same seam, and the most exact analytical tests so far made do not indicate a difference. The amount of ash associated with the coal may or may not vary, but the coal is the same, and it is coal and not coals, otherwise, every mine would produce a different kind of coal, notwithstanding the fact that seams in Illinois sometimes run through an entire county without it being possible to detect any variation in the quality; therefore, the expression, kinds of

coal, which has been used frequently in connection with coal-testing work, should not only be better defined, but limited in its application to those cases where there is a real difference, which, as is well known, does exist; for example, it must be conceded that anthracite and bituminous are different kinds of coal, but the most liberal application to this coal basin would allow only two kinds, which are the block coal of Indiana, all the remainder being bituminous, the latter also including what is known as semi-block of Indiana.

The state of Illinois has made an appropriation covering cost of investigations to be conducted by the engineering experiment station of the University of Illinois, and there is certain important work which it is hoped will be undertaken, having a bearing on the values of fuel, studies tending to define the laws controlling the influence due to the size when burned with some different kinds of stokers or grates, and similar studies to ascertain corresponding effect due to varying amounts of ash in coal, also degree of fusibility of such ash.

The recently established State Geological Survey will present by all means a very much better coal report than has so far been published by any state, and it will be a great help to the purchasers and producers of coal, if certain values as affecting heating power, ash and moisture are authoritatively presented. As before mentioned, the three essential items are heating power of the pure coal, percentage of ash in the dry coal, and moisture. The British thermal unit values would be the simplest of the three, as these results would apply to pure coal, and which is, no doubt, practically a constant for a particular locality of a seam, therefore, once determined, it will not be necessary to repeat tests. Establishing ash values would be a more difficult matter, because it would not only involve ash in seams as the coal lies in the ground, but the various grades of fuel shipped from those seams. Ash, however, at the mine would be the same in quantity as when received by the consumer. Securing moisture values would be a far more complicated problem, because of greater variation due to temperature, weather conditions and time in transit. For these reasons, it is difficult to arrive at any conclusion regarding the amount of work which may be justified in the establishment of such values. Some idea of the complication may be illustrated; for example—the washed and sized coal shipped so extensively from Williamson County has a characteristic moisture content due to the difference in the size of the pieces, the larger ones being drier, and these moisture contents vary over wide ranges between summer and winter, and also according to the length of haul; thus at least average moisture values would be needed for each size, at the city where the coal was received.

A recent expression which has come into use is that of "air-dried coal," which is based upon allowing the sample to become dried in the open air of the laboratory, the idea being that this shows the fuel as it would reach the customer. No standard conditions, however, appear to be employed in this air-drying, and if there were, the values obtained thereby do not indicate the amount of moisture in coal when it reaches the consumer. Some samples of air-drying on Illinois coal have shown the moisture as being between five and six per cent, when as a matter of fact, the same coal is never received with less than seven, and in the winter time it is very much more. This moisture value should be abandoned, as it serves no useful purpose, tending only to increase existing confusion and misunderstanding.

Double Trolley System Not a Sure Cure for Electrolysis.

At the convention of the Central States Waterworks Association, held in Cincinnati, Ohio, during the latter part of September, a discussion upon electrolysis of water pipes was started by Joseph J. Pater, who stated that it was his belief that the only method of doing away with this trouble was to force all electric railroads to adopt the double trolley system. This opinion was dissented from by George Hornung, formerly superintendent of the Newport (Ky.) waterworks, and at the present time a consulting engineer of Cincinnati, Ohio. Mr. Hornung first stated that it was not entirely correct to attribute all electrolytic troubles to the street railway, as any stray current may cause electrolysis to take place, and such currents are almost always present in cities where there are large electric generating stations. It is practically impossible to insulate all the systems perfectly so as to prevent any leakage of current.

It is this very feature which defeats the purpose of the double trolley system, and he described, somewhat in detail, his experiences with that system in Cincinnati. The double trolley system, on account of its complicated structure, is much more difficult to insulate than the single trolley system, and this fact is realized in Cincinnati, where a fallen wire is treated with respect; in fact, Mr. Horning stated that he has known horses to be killed by such wires. He mentioned an experiment conducted on Main street, in Cincinnati, at a time when there were two lines running down that street—one a single trolley, and the other a double trolley system. It was found that by transferring the trolley wheel of a car on the single trolley system to one of the double-trolley wires that the lamps in the car were lighted, and by turning the controller handle the motors, while not able to start the car exerted a considerable torque. This experiment was repeated again several years later, with the same result.

The Maximum Development of the Steam Engine.

Although would-be prophets have frequently set limits to the development of the steam engine, these limits have one after the other been passed in practice. An attempt is made here to determine if there is any physical reason for setting a limit to the increase in steam pressure and temperature beyond which it will not be possible to go. We have already reached a stage where we can use iron worked red hot, but we can not see that such high temperatures appear likely to occur in the steam engine, even though the temperature in the internal-combustion engine be considerably above red heat. The critical temperature of water and of steam is said to be about 700 degrees Fahrenheit, at which point steam and water have the same specific density and possess the same specific heat. When heated above 700 degrees steam dissociates into its elements. Unless the temperature of dissociation be raised by pressure, 700 degrees would appear to be the limit for the steam engine. Steam pressure rises rapidly with increasing temperature, and at 700 degrees Fahrenheit, or 1,161 degrees absolute, the pressure would be 2,840 pounds per square inch—about ten times higher than any that has been used up to this time. At this high pressure steam would be unstable, and it would probably be found to be desirable to allow for superheating in order to prevent this. If 200 degrees Fahrenheit be allowed for superheating, the absolute temperature of the saturated steam would be 961, which corresponds to about 674 pounds absolute pressure. From this reasoning it seems safe to conclude that it is not safe to set a limit to the steam engine until pressures have attained about 650 pounds by gauge, and temperatures 500 degrees Fahrenheit, with an additional superheat of 200 degrees. — *Electrical Review (London), September* 21.

Electrical Notes from Great Britain.

(From Our British Correspondent.)

THERE are three organizations in England which have up to the present represented electric tramroad interests. These are: (1) the Tramways and Light Railways Association, which originally seemed to be concerned with company undertakings, but now embraces all descriptions of tramway interests; (2) the Municipal Tramways Association, in whose meetings tramway officials in municipal service, and councillors, together discussed the management, engineering and finance of purely municipal undertakings; and (3) the Association of Light Railway and Tramway Officials. For some time past it has been felt that there is here quite unnecessary duplication—perhaps we ought to say triplication, and steps have been taken with a view to combining the three in one strong organization which would of course be better able to efficiently watch the tramway and tramway official interests. The matter has now come to a head, and at the annual convention which came to a close on September 21, at Leeds, a definite scheme for concentration came before the Municipal Tramways Association. The idea is to form a "Tramways Association of Great Britain and Ireland" presenting "a united front to all opponents." Already in many recent matters concerning the equipment of lines the associations have joined forces in bringing weight to bear upon the Board of Trade and Parliamentary committees.

Petrol 'buses and their odor notwithstanding, the tramway statistics for the United Kingdom show that a continual development of electric lines is going forward, though, as J. B. Hamilton, the president of the Municipal Tramways Association says, "not at the same rate of speed as in several years at the beginning of the century." The last official figures show that, including the year's outlay of $25,000,000 upon new lines, the municipal authorities have spent $165,000,000 on tramways. Tramway men have naturally been closely following the big development that has been taking place in motor-buses, therefore they heard with interest the remarks that Mr. Hamilton had to make on this point in his presidential address. This gentleman had personally had an opportunity of examining the returns showing the percentage of motor-omnibuses in operation, to those in stock, of one of the largest London companies. He also made observations concerning the vehicles of the other companies as well, and this is what he said: "the most fortunate companies had a maximum of about seventy per cent of their total stock on the road at any time, whilst many of them had only between fifty and sixty per cent." In his opinion, unless a very great improvement in reliability and economical operation takes place, the motor-bus will not long retard the extension of tramway enterprise, even in London.

The recent crop of bad accidents to street cars rendered the subject of electric car brakes one of timely interest for the Leeds meeting. A paper was read by Henry Mozley, tramway manager at Burnley, who has had special experience with different kinds of braking appliances. Full particulars of tests that he had made were given, and the following conclusions were set out as the result of his practical investigations:

1. Bogie cars are easier to control on steep inclines than four-wheel cars, whatever the character of the brakes.

2. Magnetic brakes, particularly those which affect the wheel brakes, are unsuitable for tramways either for service or safety purposes. They can only be considered as auxiliary to the rheostatic brake, and not as independent track brakes. They are highly destructive to the motors. They are treacherous and uncertain in their action.

3. The only form of brakes which will safely control a car on gradients greater than one in fourteen or fifteen are:

a. Hand brake with adequate actuating cast-iron blocks on the wheels.

b. Mechanical track brake with adequate leverage provided with cast-iron slippers.

c. Rheostatic brake for emergencies only.

Sweeping statements are always excellent things when one wants to promote a fiery discussion, and in this Mr. Mozley succeeded.

Other matters brought forward in the course of this tramway convention included: "Depreciation and Renewal Funds in Relation to Tramway Undertakings," by G. W. Holford, of Salford; "Municipal Tramway Operation," by R. A. Smithson; and "Tramway Track-work," by R. C. Bullough.

There is at present running at Olympia in London, where last year's great electrical exhibition was held, an engineering and machinery exhibition about which a great deal of fuss is being made in newspapers and some trade papers. It may no doubt be a useful show from some points of view, but to electrical engineers it is of only very small interest. A probable explanation of the comparative absence of electrical firms from among the exhibitors lies in the resolution passed by the National Electrical Manufacturers' Association that its members would not show at any exhibition except those conducted under its auspices. We are not sure whether that decision was intended to relate to such an exhibition as the present one; from the fewness of electrical exhibitors we should imagine it was. The British electrical manufacturer generally speaking is not very keen about exhibitions. The manufacturers' association mentioned does not hold upon its membership roll a number of the most powerful British electrical manufacturing organizations, so these were not bound by resolution. However, these have not thought it worth while to be represented at the engineering and machinery exhibition. The promoters of the exhibition sought to include electrical engineering exhibits, and a few of these might have helped to occupy some of the space which is now vacant—there is not even a spanner in the entire gallery round the great hall—its sole occupants are a brass band. The daily papers are talking of so many miles of exhibits, and quoting estimates of the aggregate weight of the machinery on view so as to draw the public to Olympia, but it is not a show to appeal to the public like last year's electrical exhibition which was so popular. Engineering students will of course find many things there to interest them.

English electricity supply companies, municipal electricity committees, and their managers and engineers are alive at last to the necessity for acting more enterprisingly—shall we say with more of your hustling?—in order to develop the electricity selling business. The prize papers published as part of the scheme of the Cooperative Electrical Development Association, of Cleveland, Ohio, have been studied with considerable interest and they are bound to do good on this side of

the Atlantic as well as that. We have been so busy for years (and are still) turning out new electrical engineers that there is no lack of technical assistance obtainable at cheap rates, and the man with genuine salesman ability and just enough technical knowledge to keep him from making a fool of himself, is going to be valued more and more in this electricity supply business. We are not sure that it would be incorrect to couple poets and downright energetic business-getters together in one thing (perhaps not more) —they are born, not made.

For sometime past several schemes have been on foot for supplying ample and cheap electric power to the Rand district. The Rand Central Electric Works, Limited, a German concern very largely, though nominally a London company, is making extensive preparations, but this effort pales into insignificance at the side of the other gigantic schemes which are in process of elaboration. One of these big projects is said to be almost ready for an appeal to the public, and within the next month or six weeks, if the reports be correct, $15,000,000 of shares will be offered by the company which has resolved to proceed with the works for electrical transmission from Victoria Falls to both Pretoria and Johannesburg. The distance from the Falls to Johannesburg is 600 miles "as the crow flies," but the necessary deviations will make a transmission of 700 miles. One report says that 150,000 volts is the proposed pressure, and that the first instalment of plant will be equal to 30,000 horse-power, it being intended to add to it as the demand necessitates. ALBERT W. BRIDGE.

London, September 29, 1906.

Instructing Telephone Operators.

To the traffic department of the New York telephone system the girl who wishes to become an operator must direct her steps. The qualifications necessary are good eyesight, good hearing, distinct enunciation, fair penmanship and general neatness. At least medium height is required, and a bit over is an advantage. Recruits should be between seventeen and twenty-one years of age, and should have a good common-school education. Of course satisfactory references as to good character are required.

To teach these recruits the art of telephone operating the company maintains a school where more than a hundred embryo hello girls are always in training. They are taught telephone geography in order that they may accurately locate the point to which a call should be sent, and start the call without an instant's loss of time. All are taught to do things in exactly the same way; to respond to the signal of the calling subscriber with the one phrase, "Number, please," to answer all calls and inquiries and complaints courteously, always using the rising inflection, as allowing the voice to fall conveys a disagreeable impression at the other end of the wire. The thought is installed into their minds that in telephoning a great deal depends on courtesy. They are taught that "A soft answer turneth away wrath."

After this course of training, lasting more than a month, the latter part of which is given over to actual operating on the practice-board in the school, the girls are graduated and apportioned among the exchanges needing new operators. In this allotment, so far as possible, the girls are sent to exchanges near their homes. This bit of courtesy on the part of the telephone company saves a good many nickels and much time to the operators in the course of a year.

While going to school, the operators are paid a salary of $5 a week, which is increased as they progress in the regular force, the average pay of the operators being about $10 a week. From the ranks of the regular operators promotions are made from the grade of senior operator to supervisor.

The comfort of the operators is well looked after. At each exchange the company maintains a kitchen, dining room, sitting room, supplied with periodicals, an emergency hospital, a locker room with an individual locker for each operator, all of the quarters being well ventilated, well lighted, clean and pleasant. Hot tea and coffee are furnished to the operators, and they can obtain these at any time. In addition to the regular lunch hour, the girls are allowed a relief period of thirty minutes in the morning, and another in the afternoon, which they spend as they see fit in these rooms. This welfare work in each exchange is under the direction of a matron.

The regular operating force is drawn on frequently nowadays to provide operators for the numerous small private exchanges which are located in nearly every establishment of any size in the city. At the present time in New York city there are about 25,000 telephone operators.—*H. K. McCann, in N. Y. World.*

Single-Phase Equipment for the Washington, Baltimore & Annapolis Railway.

The announcement that the Washington, Baltimore & Annapolis Railway has finally adopted the single-phase system and has placed contracts for the entire electrical equipment required for this line will attract considerable interest in engineering and railway circles.

In the former plans for this system of single-phase equipment between Baltimore and Washington it was proposed to use a trolley potential of 1,000 volts, current being delivered at this voltage at a frequency of sixteen and two-thirds cycles per second. The present contract calls for a trolley potential of 6,600 volts at a frequency of twenty-five cycles per second. On the cars a four-motor equipment was proposed, each motor having a capacity of 100 horse-power. The new car equipments will consist of quadruple General Electric A-603 motor equipments for direct or alternating currents, each motor having a capacity of 125 horse-power. While the first proposed motor equipments would have driven the cars at about forty miles per hour, the new equipments, totaling 500 horse-power, will enable express trains on the road to attain a speed on tangent level track of sixty miles per hour.

The details of the new road have been carefully worked out by the Roberts & Abbot Engineering Company, of Cleveland, Ohio. Single-phase equipment was chosen only after the most careful engineering study had made it apparent that this system would prove most economical and best adapted to meet the special service conditions existing on this road.

Some sixty miles of road will be operated by the new company. The main line will be constructed between Baltimore and Washington, with a branch line, from a point on the main line near Odenton, extending to Annapolis. This station on the new line will be known as Academy Junction. Over the main line between Baltimore and Washington an express and local service will be established, express cars being operated under a fifteen-minute headway and making the run in seventy-two minutes. The roadbed will be double-tracked throughout, with sidings arranged at suitable intervals so that the locals may be side-tracked to enable the expresses to maintain schedules. The rolling-stock equipment is to be very complete. Nineteen express cars, capable of making sixty miles per hour on a tangent level track, will be operated. In addition two work-

cars will be equipped, each sufficiently powerful to haul a train of five ordinary passenger coaches at forty-five miles per hour, while four lower-powered cars will be used for local service. These last-mentioned cars will run at a speed of forty-five miles per hour. The express and work cars will each be equipped with four General Electric A-603 (125-horse-power each) alternating-current-direct-current motor equipments with the Sprague-General Electric type M train control. The local cars will be similarly controlled but will be driven by two instead of four General Electric A-603 motors.

Power for the new road will be purchased from the Potomac Electric Company, of Washington, D. C., and will be delivered by that company at 6,600 volts, three-phase to a transformer substation located about three miles from Chesapeake Junction. In order to obtain a balanced load on the three-phase generators, the current as received at the substation will be changed from three-phase to two-phase by groups of two transformers connected three-phase on the 6,600-volt primary side and two-phase on the secondary side. Half of the transformers will have the secondaries wound for 6,600 volts and the other half for 33,000 volts. The 6,600-volt windings will all be connected in parallel on the same phase supplying single-phase current to the trolley as far as Academy Junction. The 33,000-volt secondary windings will all be connected in multiple on the second phase to the 33,000-volt transmission line, which will supply current to a step-down substation located at Academy Junction. The Chesapeake Junction substation will contain seven 800-kilowatt, water-cooled transformers, three with 33,000-volt secondaries and four with 6,600-volt secondaries, one of the latter transformers forming a reserve.

At Academy Junction there will be four water-cooled transformers, twenty-five cycles, 800 kilowatts, reducing the single-phase 33,000-volt current of the transmission line to 6,600-volt current suitable for delivery to the cars. These transformers will supply the Baltimore and the Annapolis sections of the line.

The substation at Academy Junction will be located adjacent to the car barns. For greater safety in inspecting and handling the cars, all of the trolley circuits in the car barn will be arranged for 600-volt direct current, and for this purpose two 300-kilowatt motor-generator sets will be installed in the transformer substation, changing the 6,600-volt alternating current to 600 volts direct current. The motor end of these motor-generator sets will be connected direct to the trolley circuits, one phase being led from the trolley coming from Chesapeake Junction and the other from the Academy Junction transformers. A feeder regulator will be placed in one phase so that the motor-generator sets will act as balancers, permitting the Academy Junction transformers connected on phase B to feed into the trolley line supplied by the Chesapeake Junction transformers on phase A. In addition to acting as balancers and to supplying current to the cars in the barns, the motor-generator sets will also supply direct current to the motors in the repair shops located at this point.

Government regulations within the District of Columbia prohibit the use of the track return so that within this section the cars will be operated with a double trolley. This portion of the tracks, as well as that within the city of Baltimore, is at present operated by direct current, and the new cars are designed to operate on direct current over these sections of the line.

The present Washington, Baltimore & Annapolis Railway Company which is constructing the line is quite distinct from the initial corporation. The new company, under the head of its president, George C. Bishop, has considerably broadened the former plans. Land has been purchased for a wider right of way along the route, and new bridges are being built, so that the roadbed will be excellent. The engineering work is in charge of the Roberts & Abbot Engineering Company, of Cleveland, Ohio, and contracts have been placed with the General Electric Company for the complete electrical equipment. The construction and operation of this road will be watched with great interest, as it is one of the largest and most important installations of the single-phase railway system ever undertaken.

The New Plant of the Home Telephone Company, Detroit, Mich.

The plant of the Home Telephone Company, Detroit, Mich., is being built by the Electric Construction Company, St. Louis, Mo. The same interests control both the telephone and the construction companies. The Commonwealth Trust Company, of St. Louis, Mo., is financing the proposition, and its resident representative is W. W. Grayson, formerly of the Kinloch Telephone Company.

A site for the central exchange property has been purchased at the northwest corner of Madison avenue and John R. street. This gives 105 feet on Madison avenue and 100 feet on John R. street. The plans and specifications contemplate a building to cover the entire lot, three stories high, and devoted entirely to local and long-distance service. It is expected that the building will be ready for occupancy by May 15, 1907. The first floor, containing 10,000 square feet, is devoted to public and executive offices. The second floor is devoted to the long-distance board, hospital, rest room and lockers for the operators, terminals, battery room and office of the long-distance wire chief. The third floor is for switchboard exclusively. Under the building is a large basement for shops, storage purposes, etc.

For its east exchange the company has purchased property at the corner of Field and Sylvester streets, and for the Delray office property has been purchased at the corner of Artillery and Lafayette streets.

Contracts have been awarded for central office switchboards and substation telephones. The total present switchboard capacity is 15,000 lines, with an ultimate capacity of 40,000 lines. The number of substation telephones covered by the contract is 10,000. The contract has been awarded to the Dean Electric Company, of Elyria, Ohio, and the total amount of the award is about $500,000. Contracts have also been awarded for underground cables which are to be drawn into the conduits at present being constructed by the company. The contracts have been awarded to the John A. Roebling's Sons Company, Trenton, N. J., and to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

Evening Courses in Direct-Current Testing at the Polytechnic Institute, Brooklyn.

The evening sessions in direct-current dynamo-testing were begun on Thursday evening, September 27, at 7.30 o'clock, at the Polytechnic Institute, Brooklyn, N. Y., under the direction of the class instructor, Sydney W. Ashe. This class extends over a period of twenty successive evenings, from 7.30 to 9.30 o'clock, and is similar to the course given during the day. The course involves a series of tests of the construction, regulation, efficiency and operation of direct-current dynamos and motors, together with a consideration of the efficiency and distribution of light, and the candle-power of arc and incandescent lamps.

From those desiring to have their work credited toward the degree of electrical engineer, engineering reports upon the tests performed will be exacted.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Artificial Dispersion of Fogs by Electricity.

The problem of artificially dispersing fogs has been studied by Maurice Dibos for some years past. As long ago as 1899 he endeavored to accomplish this by means of compressed air discharged from the bow of a steamer. Still later he took up the electrical method, using both alternating and direct currents, and succeeded in clearing zones from 100 to 150 metres in diameter. As soon as the discharge was stopped the fog at once closed in again, but dispersed upon renewing the discharges. Although what has been done in this direction is small, it points to possible important developments which would be particularly valuable in important commercial ports. The article gives a review of all the work that has been done upon this problem, and gives some data showing the amount and kind of solid matter found in the air of certain large cities.—*Translated and abstracted from L'Electricien* (*Paris*), *September* 22.

Experiments with the Heusler Magnetic Alloys.

Some interesting experiments have been conducted by K. E. Guthe and L. W. Austin with a number of samples of the Heusler magnetic alloys. After a brief review of preceding work with these alloys the latter are described. They consisted mainly of copper, manganese and aluminum, but contained from one to one-half per cent of iron, from a trace to about four per cent of lead, and a small amount of silicon. A few other elements, such as carbon, phosphorus and silicon, could be detected in certain of the samples. Experiments to determine the modulus of elasticity were unsuccessful, due to flaws in the samples; and while not even an approximate value for Young's modulus may be given, it is apparently very large. Magnetization curves were obtained, the induction being carried to high values. These curves resemble closely those for iron, the curve for one sample being very like that for a hard substance. Two of the samples were but slightly magnetic. Curves for permeability and induction were plotted. The greatest value for permeability found was for one sample in which it reached about 575 at an induction of 1,800. Curves for magnetostriction were obtained. It was found that the expansion of the samples was not proportional to the magnetization, but increases more rapidly. It is relatively larger the softer the material. From the result it seems fair to conclude that the harder the alloy, the higher Young's modulus. The thermoelectric forces were also determined. It was found that these were unaffected by the magnetic condition of the sample. The conclusion is drawn from the investigation that in these alloys certain properties seem to be absent which have always been thought to be closely connected with magnetic substances.—*Abstracted from the Bulletin of the Bureau of Standards* (*Washington*), *August.*

Grounded Neutrals with Series Resistance.

The advantages and disadvantages of grounded neutrals on polyphase systems are discussed here by P. H. Thomas, particular reference being made to the system of the Interborough Rapid Transit Company, of New York city. Broadly speaking, the advantages of the grounded system are the limitation of the rise of potential to earth that occurs when one line of a system becomes grounded, and the causing of a short-circuit if one line wire becomes grounded, thus opening the circuit-breaker on the grounded feeder. The disadvantage of a grounded neutral is the fact that a single ground is sufficient to cause a short-circuit and an interruption of the service. On systems which can be repaired without disconnecting the feeders the grounded neutral would therefore be objectionable, but for high-tension wires which must be disconnected anyhow for repairs, this disadvantage is not so great. In plants having a large number of feeders, any one of which may be cut out without affecting the system, it is possible to arrange the grounded neutral so as to open a particular feeder without shutting down the rest of the system. This is done by inserting resistance in the ground wire of the neutral. This resistance tends, however, to prevent the realization of the advantage of the grounded neutral, since it hinders the free flow of current to the earth. With comparatively high resistance, short-circuit troubles are limited and the circuit-breakers open quietly, but the current taken is not sufficient to prevent a rise of potential to ground on the rest of the system. As this resistance is made relatively less, the short-circuit current becomes greater, and the rise of potential is better controlled. On the Interborough system a resistance of about six ohms, allowing nearly 1,000 amperes to flow, has given the most satisfaction. Additional complications arise when several generators are employed, for if but one resistance be placed in the ground wire a serious overload may occur when only a few generators are in operation. It seems better to connect each generator to the ground through its own resistance, but when this is done switches must be provided for disconnecting the idle generators from the neutral bus.—*Abstracted from the Electric Journal* (*Pittsburg*), *September.*

Continuous-Current Dynamos with Auxiliary Poles.

The magnetic effect of the auxiliary poles on the field of a continuous-current dynamo is discussed here by A. Lioubille. It is shown first that in a two-pole machine having two field coils there are two points in the yoke midway between the poles having the same potential as the centre of the armature core. If, therefore, two auxiliary poles be placed at these points they will, if not excited, in no way affect the magnetic distribution of the dynamo. Exciting the two coils causes merely the superposing of the auxiliary field upon the main field, and this is shown to be the case both theoretically and experimentally, because, while the theory assumes that the reluctance of the circuit remains constant at all points, the inductance will be affected appreciably only in the yoke, and the latter is not generally saturated. The study does not take up the question of magnetic leakage, which undoubtedly would be seriously affected by the auxiliary poles. This effect will be very complicated, but it may be reduced considerably by the plan proposed by R. Pohl, in which the auxiliary poles are shifted around until they are brought close to the main poles of similar sign.—*Abstracted from L'Industrie Électrique* (*Paris*), *September* 10.

The Use of the Wehnelt Interrupter with the Righi Exciter for Electric Waves.

In making a quantitative investigation of the performance of the Righi exciter, as usually employed, it is usually necessary to make the measurements by a very sensitive galvanometer. To get around this disadvantage, A. D. Cole considerably increased the energy of the vibrations by adopting a Wehnelt interrupter and modifying the exciter so that it would operate cool. The latter condition was obtained by circulating oil through the oil cup. Considerable difficulty was found in devising an interrupter of this type that would operate satisfactorily and not go to pieces after a short time. Various forms of adjustable electrode were tried, sealed into glass or covered with rubber, but none was satisfactory. Small discs cut from the bowl of a clay pipe were but little more durable. Compressed asbestos and a hard kind of talc were tried and rejected. Good results were obtained finally by using small discs cut out of a piece of close-grained slate. A small hole was drilled through the centre of the disc, which was then cemented to the end of a glass tube. A platinum wire passed through a cork inserted in the opening, the cork being forced into the upper end of the glass tube. This tube was allowed to project into weak sulphuric acid, a dilute solution being more convenient for handling, and the increased resistance being an advantage, rather than a disadvantage. The other electrode was formed of a strip of lead bent into U form. An alternating current of 100 volts was used for exciting this interrupter. Although it could be used without any resistance being inserted, better results were obtained when a resistance of about seven ohms was placed in the primary circuit, the platinum wire being pushed out through the slate until about two millimetres projected into the acid. The amount of resistance used in series with the interrupter must be varied with the length of platinum wire exposed. This device proved very satisfactory in action.—*Abstracted from the Physical Review (Lancaster), September.*

Oscillographs and Some of Their Recent Applications.

A convenient form of oscillograph is described here by B. A. Ramsay, the apparatus permitting not only continuous records of current and electromotive force to be obtained, but short typical curves to be made, at the same time the curves are plainly visible. Or it may be adapted for projecting curves on a screen. The device is particularly adapted for studying high potentials up to 30,000 volts. The oscillators are mounted on a tall corrugated porcelain insulator, over which a porcelain cover is set. A plate of porcelain is interposed between the oscillator and the box containing the sensitive surface, in order to prevent troubles from brush discharges. Two vibrating systems are mounted independently, so that either may be taken out for adjustment or adjusted within the magnetic field. Instances are described in which a device of this kind proved of much commercial value. It was found that the wave form from a certain alternator was rather irregular, and these irregularities were greatly magnified when it was connected to unloaded cables. A slight change in the shape of the pole face remedied the trouble. It was found that the luminous efficiency of an alternating-current arc is forty per cent higher when supplied from an alternator with a flat-top electromotive-force curve, than from a machine with a peaked curve; so that where arc lighting forms a considerable portion of the load it is important to select an alternator having a suitable wave form. On the other hand, transformers have a higher efficiency with peaked wave form. Some interesting investigations were made showing the shape and phase of the current and electromotive force during electrolysis. An interesting result is given, in which the current leads the electromotive force by about forty-five degrees and shows peculiar irregularities when at its higher values. A simple synchronous motor has been devised for use with this apparatus, which is an induction motor with a short-circuited rotor, the core of which is, however, deeply slotted at four points. It has a two-phase winding and starts as a split-phase induction motor, but runs up into synchronism and operates as an attracted iron motor.—*Abstracted from the Electrician (London), September 21.*

Phenomena Observed in Crookes Tubes.

No satisfactory explanation seems to have been made of the phenomena characterizing prolonged discharges in a Crookes tube. These are considered here by N. T. Bacon. They are, first, a discharge of peculiar rays from the anode, a discharge of different peculiar rays from the cathode, gradual attenuation of the discharges, recrudescence of discharges on heating the walls of the tube, and coating the walls with platinum black. To explain the attenuation of the discharge and its reappearance upon heating, it has been suggested that the gases in the tube might be absorbed in the pores of the glass vessel; but this hardly seems rational, because the walls of such vessels are very thin, and if absorption could take place there would probably be a kind of osmotic transfusion from the glass through the outside. It seems reasonable to ascribe the gradual attenuation to increasing vacuum, since it is partially overcome by heating the tube; and it might be that the gases accumulate on the glass, forming a sort of surface film, such as is known to be formed under atmospheric pressure. The same explanation might account for the heating of platinum sponge in an atmosphere of hydrogen, as the gas might be condensed even to the point of liquefaction. If molecular elasticity be more or less imperfect in the solid state, a molecule of hydrogen, striking an imperfectly elastic platinum molecule, would rebound with diminished velocity, the lost kinetic energy going to raise the temperature. In the pores of the platinum sponge the hydrogen molecule will naturally strike again and again the imperfectly elastic mass, with further evolution of heat and loss of velocity, until it reaches nearly the orbital velocity of the vastly heavier platinum molecule, and may thus be reduced even to the liquid condition. Such a film would give off molecules when heated, and, knowing platinum black to have this action on gases in higher degree than glass, the vacuum in the tube might be increased by the platinum coating, and the heating of the walls of the tube would partially restore the latter to its activity. The higher the vacuum the more important relatively this action becomes, as the exposed surface of imperfect elasticity remains constant, while the number of gaseous molecules diminishes. This idea may sufficiently explain the recrudescence on heating the walls of the tube, but it does not explain the emission of rays, and hardly seems sufficient for the continuing gradual increase of vacuum. These might be accounted for on the hypothesis of a resolution of atoms into electrons or emanations, under the discharge in a Crookes tube, and radiation of these, to which the glass walls might be pervious. It is possible, for these reasons, that there may be present some of those ethereal forms of matter postulated to account for the curious changes attending the transformation of radium to helium. From present indications, it is not improbable that under these limiting conditions the electric discharge can only take place by a disruption of atoms. There is the intermediate possibility of the mere disruption of molecules into nascent atoms, but this would not continually intensify the vacuum, though it might be an intermediate stage.—*Abstracted from the American Journal of Science (New Haven), October.*

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

The accompanying illustrations will convey two distinct impressions. One is that which appreciates the spectacular and out-of-the-ordinary in advertising, and the other that which appreciates the attempt to create desire and educate by means of an orderly and artistic presentation of facts and figures. Each of these ideas is effective—very effective.

The Muskegon Traction and Light Company, Muskegon, Mich., which owns the gas company in Muskegon is the user of electric cars, electric signs and electricity to sell gas. This form of publicity, it is understood, has been very successful—so successful, in fact, that the company is considering increasing the number of cars thus illuminated. All of which shows

A Novel Gas Advertisement.

the rapidity with which these advertising bugs are boring into our sensibilities. First, there was danger of arrest for sticking a paster or hanging a circular inside of a car; then some enterprising soul suggested a few dignified cards announcing special products; then whole systems were turned over to syndicates controlling every bit of available space in the car so that if the traction company has an announcement it must cut out the light from one of the windows; and now the outside of the cars are attractively calling attention to the other commodity the company has to sell. This is certainly a period of utilitarianism, and under the guidance of the admasters the public service companies are carrying two persons where one walked before; burning two lamps where hitherto a single candle flickered and providing a gas spigot where not so long ago the wood box and scuttle were in the way of a man's feet and peace of mind.

The folder illustrated herewith is from the Philadelphia Electric Company. Notwithstanding some natural prejudice against blanket advertising, no one can say that this is not attractive and convincing. The color design is simple black and red, and the stock is a soft gray. The folder combines an argument; facts and figures in connection with recent installations, and a return postal suggesting an enquiry.

TRACING RESULTS

TRACING the results of using Electric Power with current from The Philadelphia Electric Co., is as sure and satisfactory as tracking the footprints of an animal in soft earth. Tracing results is a pleasant occupation if it shows dollars saved or dollars earned. Do you know how much your power is costing you? Not ABOUT how much but EXACTLY! Will you let us show you? It won't cost you a cent to find out, and even if you don't decide to use our Power, you will have learned whether your present supply is economical or the reverse. During the past three months we have introduced Philadelphia Electric Service and shut down many of the largest private plants in the City. Examine the List printed below, and then send for particulars.

THE PHILADELPHIA ELECTRIC COMPANY

TENTH AND SANSOM STREETS — BOTH 'PHONES

The following are a few of those who have lately connected for Philadelphia Electric Service:

NAME	LAMPS	H.P.
The North American Co.	4000	700
The Jefferson Hospital,	3000	375
Standard Roller Bearing Co.		200
Record Publishing Co.	2000	430
Armour & Co.	1000	200
R. H. Foerderer & Co.		200

Dear Sirs:

Providing that there is neither expense to us, nor obligation in the matter, kindly make comparison of the cost of our present power supply with Philadelphia Electric Service. What method did you pursue in shutting down the plants mentioned?

Yours truly,

Name

Address

A Folder from the Philadelphia Electric Company, Opened.

A Folder from the Philadelphia Electric Company, Closed.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Metallic Support for Cross-Arms.

A device of special interest to constructors of power transmission lines, interurban railways and even electric light systems is shown in the accompanying illustrations. The device is a steel gain, which is clearly shown in Fig. 1. In this illustration it will be seen that the cross-arm is attached to the pole by means of a metal fixture composed of two plates engaging each other and at the same time engaging the cross-arm and the pole. The curved steel plate embraces the pole, while the gain plate, which is provided with projecting braces or tongues, supports the cross-arm. The tongues of the gain plate pass through apertures in the pole plate and fasten into the pole. Shoulders on these braces clamp against the pole plate and afford a most rigid support for the gain. The pole plate normally has a greater radius than the largest pole top, and when drawn into place not only conforms closely to the circumference of the pole, but, by pulling the gain toward it as it is clamped into place, provides sufficient spring tension to compensate any shrinkage in the pole or cross-arm.

Again referring to Fig. 1, it will be seen that the device is attached by one through bolt, which passes through the cross-arm, the gain plate, the pole plate and the pole, and is held by the usual square washer and nut. The pole plate is afforded an additional support by the two lag screws, one placed above and the other beneath the gain.

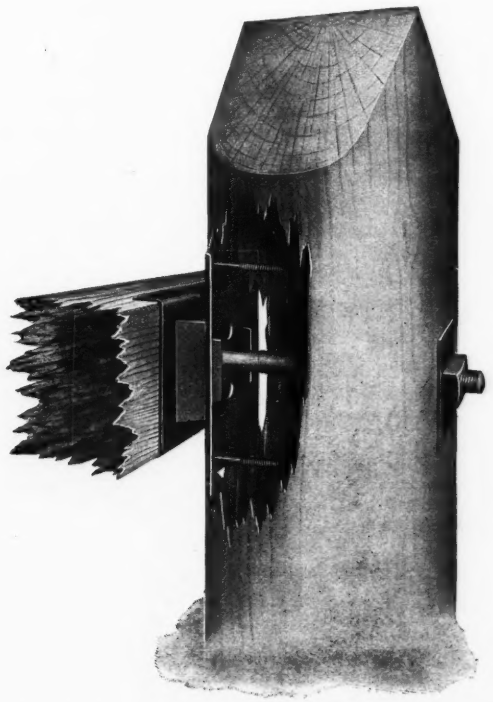


FIG. 1.—STEEL GAIN IN POSITION.

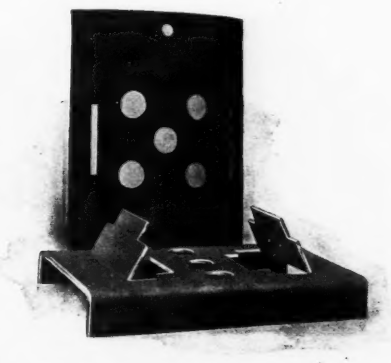


FIG. 2.—PARTS OF STEEL GAIN.

The advantages claimed from the use of the steel gain are numerous. The device, when properly fastened in place, supports a five or six-foot cross-arm so rigidly that cross-arm braces are unnecessary. This is a decided advantage, as the cost of cross-arm braces and the cost of cutting a gain are saved. A further saving is effected in mounting the arm with this steel gain, as the relation of the gain to the pole plate is such that the arm is brought into perfect alignment without the usual sighting and without the use of a square. Still another advantage is derived from the fact that this steel gain, when in place, adds to the strength of the pole instead of reducing the strength at a point where it is most needed.

While the advantages of construction are of great importance, undoubtedly the most valuable feature of the device is noticeable after the power transmission line, or whatever other line the device is used on, has been put into operation. The use of a single metallic cross-arm brace or a pair of metallic braces causes a noticeable loss of current by leakage. This leakage is greatly increased during damp, rainy or snowy weather. The steel gain, by eliminating the cross-arm braces, reduces this troublesome feature in power transmission work and makes it possible to use a shorter arm.

Although the steel gain is new so far as heavy work is concerned, a smaller and lighter gain has been used in telephone and electric light work for a little more than two years. In the lighter branches of construction it affords the same advantages, and it has proven itself an economical and satisfactory support for cross-arms. Various sizes are made to accommodate telephone and electric light arms, as well as the heavier arms for power transmission lines. The pole plates of the lighter gains are not extended as are those shown in the illustration, but they are sufficiently long to afford a rigid support.

When shipped from the manufacturer the two plates are assembled, the tongues of the gain plate engaging the pole plate so that the device may be considered as a single unit. Both the pole plate and the gain plate are made of No. 12 Bessemer steel, and the weight of the large gain for five-inch arms is approximately three and one-half pounds. The gains are furnished plain or galvanized, as ordered.

The Marshall Electric Manufacturing Company's Standard Dial Switch.

The Marshall Electric Manufacturing Company, Boston, Mass., has recently designed, and is now putting on the market a new form of indicating surface snap switch for 250 volts. The dials on these switches are securely locked in position by a plug or projection rigidly fastened to the switch spindle spring plate, which projects through a corresponding hole in the dial, so that there is no possibility

STANDARD DIAL SWITCH.

of the dial being misplaced and giving the wrong indication.

These switches are also equipped with eccentric binding posts, giving an unusual thickness of metal through which the binding screws are threaded. The cover is lined with hard paper drawn in a smooth, continuous cup without seams or corrugations.

These switches are carried in stock at the New York office, 227 Fulton street; at the Chicago office, 169 Adams street, as well as at the Boston works.

A Fifty-Ampere Dry Cell.

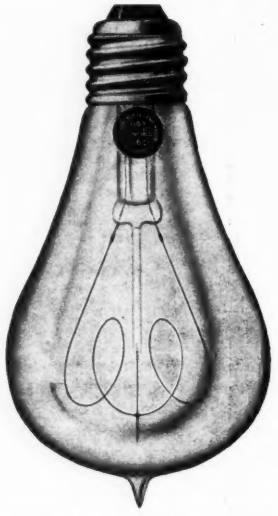
The French Battery Company, Madison, Wis., is placing on the market a new dry cell designated as the "Auto Special," which has an initial output of fifty amperes. Besides this large output the tests made are said to have proved that the recuperative power is in every way equal to the high discharge. This is a cell of standard size, two and one-half by six inches.

While introducing this battery, the company realizes that there is only a special class of consumer desirous of buying a battery with this high amperage. The company is, therefore, making four different types of battery. These types are manufactured on different principles, and show, therefore, different results in discharge. The company makes the "Bell" type, giving from twelve to fifteen amperes; the "Telephone" type, giving from twenty-two to twenty-five amperes; the "Ignition" type, giving from thirty-two to thirty-five amperes, and the "Auto Special," giving from forty-five to fifty amperes.

The company is now located in its new factory building, which has been erected to give facilities for supplying the increasing demand for these batteries.

The Franklin Electric Manufacturing Company's Street Railway Incandescent Lamp.

The accompanying illustration shows the incandescent lamp developed for street railway use by the Franklin Electric Manufacturing Company, of Hartford, Ct. This lamp will be demonstrated in building 4, section B, booth 30, of the manufacturers' exhibition at Columbus, Ohio, in conjunction with the meeting of the American Street and Interurban Railway Association, to be held next week. A feature of the demonstration is a vibrating machine designed to reproduce the



ANCHORED FILAMENT STREET RAILWAY LAMP.

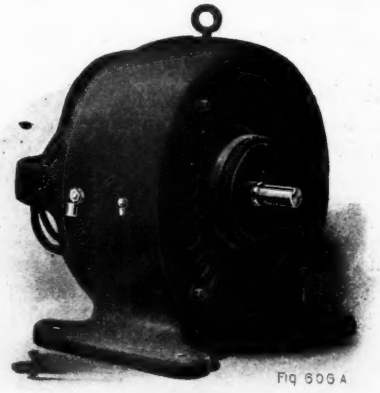
conditions under which the incandescent lamps operate in street railway service. This exhibit is intended to show the effectiveness of the Franklin company's lamps in this field.

In this lamp the filament is anchored at its lowest point and is supported directly from the stem. This is accomplished by means of a small glass column extending from the stem past the upper portions of the filament coil. The filament is securely fastened to an anchored wire welded into the glass column, and the greatest possible rigidity of filament support is thus obtained.

Through this method of construction the lamp sustains vibration equally well at all parts of the filament. Any possibility of the filament drooping or touching the bulb is removed. The lamp is made of specially selected materials throughout, and is constructed particularly to resist hard usage.

Small Generators Arranged for Direct Connection.

To meet the demand for a small direct-connected steam or gas-engine-driven generator for isolated plants or private residences, the Crocker-Wheeler Company,



C.-W. FORM 1 MACHINE ARRANGED FOR DIRECT CONNECTION.

Ampere, N. J., has developed a type of machine especially arranged for this purpose, consisting of a magnet frame and armature with shaft. The commutator end of the shaft is carried in a bearing supported by a rigid bracket which is bolted to the side of the frame, and the inner end of the shaft is finished to receive the engine coupling. The general appearance of this machine is well shown in the accompanying illustration.

The magnet frame of this machine is of cast iron, circular in form and of compact and pleasing design. The machines are of the multipolar type, and the frames are cast with feet for attaching to the engine subbase. The poles are round and of cast steel, welded into the magnet frame, provided with removable shoes which hold the field coils in place.

The brushes are held in a brush box pressed against the commutator by an adjustable spring. The studs carrying the brush-holders are firmly attached to the rocker arm and thoroughly insulated. All brushes may be shifted simultaneously by rotating the rocker on its seat.

The field coils are wound on forms and thoroughly insulated, the outer surface being protected from mechanical injury by a covering of stout insulation coated with moisture-proof varnish.

The armatures are of the iron-clad type with formed coils laid in open-top slots. The slot insulation is composed of pressboard, oiled muslin and mica cloth.

The machines will run continuously under full load with a rise in temperature above the surrounding atmosphere not ex-

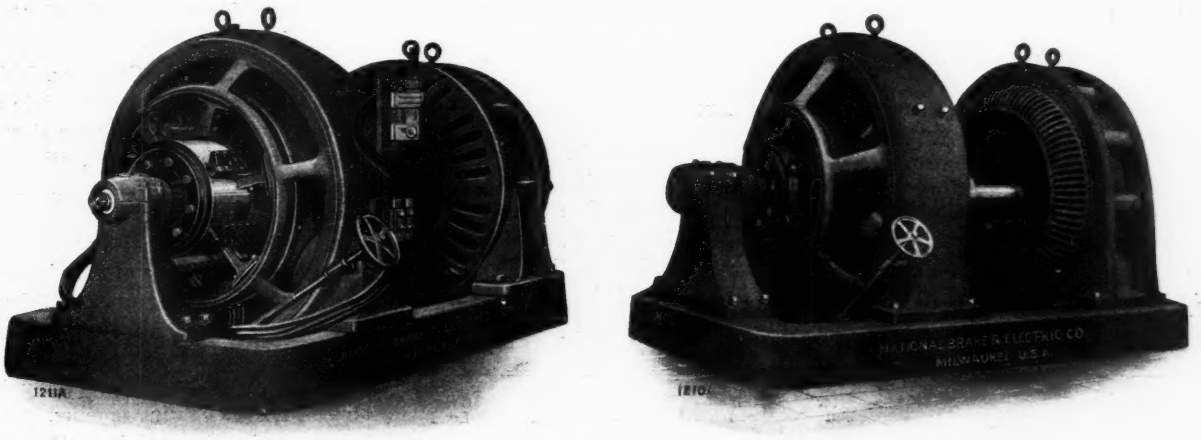
ceeding forty-five degrees centigrade in any part. They will carry twenty-five per cent overload for one hour, and with the brushes set in proper position will work under any variation of load between no load and full load without sparking, and will stand fifty per cent momentary overload without injury.

National Motor-Generators in the Substations of the Columbus, Ohio, Railway and Light Company.

The power plants and systems of the Columbus, Ohio, Railway and Light Company are among the most modernly equipped stations in the Central West, embodying as they do the newest and latest practice in equipment and operation. The company was incorporated in Ohio in 1903 and acquired by lease the Columbus Railway Company and the Columbus Edison Company. On July 1, 1906, the company also acquired operating control of the Central Market Street Railway, which was one of the Appleyard properties, but was obtained by the Ohio syndicate at a receiver's sale. The Central Market Street Railway owns sixteen miles of track and leases fifteen miles. The Columbus Railway and Light Company owns 107 miles of track, making a total of 138 miles in the combined system.

The system consists mainly of broad-gauge lines on which 331 cars are operated. On the standard-gauge lines, about sixty cars additional are operated, making a total of nearly 400 cars in use. The majority of these cars are equipped with General Electric No. 67 motors, with a scattering of General Electric No. 52 and No. 800 and Westinghouse No. 12 and No. 49.

Current for operating the railway and lighting system is generated in four stations with an aggregate output of 10,000 kilowatts. The smallest of these is the Milo station, just outside of the city limits, which had a capacity of 800 kilowatts. The Milo station has within the past month been converted into a substation, and a National 500-kilowatt motor-generator set installed to supply current to the system in this district. This set is of the three-bearing type and consists of a 750-horse-power, three-phase, sixty-cycle, 600-revolutions-per-minute synchronous motor, receiving current at 4,100 volts and driving a 500-kilowatt direct-current generator which generates current at 575 volts and 870 amperes. The construction of these machines provides for a liberal rating and low temperature rises and at the same time gives a compact set of very rugged appearance and graceful lines.



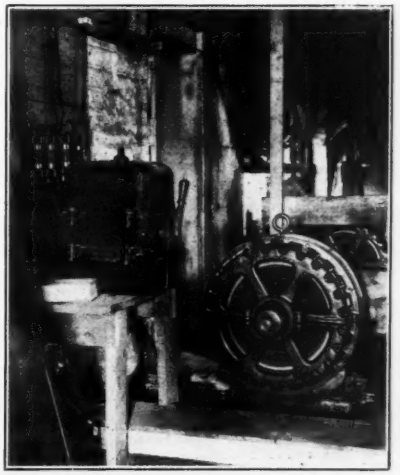
National Motor-Generators in the Substations of the Columbus Railway and Light Company.

The Columbus Railway and Light Company has also recently installed a National induction motor-generator set in a new substation at the corner of High and Town streets. This set is used for bridging in on the underground Edison lighting circuit. This set comprises a 375-horse-power motor wound for three-phase, sixty-cycle, 4,100-volt current and driving a 250-kilowatt, 250-volt, direct-current generator at a speed of 720 revolutions per minute. The present connected lighting load of the company is about 150,000 sixteen-candle-power lamps. In the business section of the city the lighting system is underground.

Electric Power in the Plant of the Springfield Metallic Casket Company, of Springfield, Ohio.

Electricity as a motive power for the operation of industrial plants has, by its obvious advantages, come into general use in all branches of manufacturing. The simplicity of electric motors, the ease with which they can be applied to almost any class of work and the flexibility attending their use has created a large field for electric drive which is rapidly superseding the methods formerly used. An illustration of this fact is found in the plant of the Springfield Metallic Casket Company, of Springfield, Ohio, where the rapidly increasing business created power demands that were considerably in excess of the steam engine equipment, and electric motors were installed in preference to additional steam capacity. This company manufactures high-grade metallic caskets with self-locking covers that can not be removed when once placed in position.

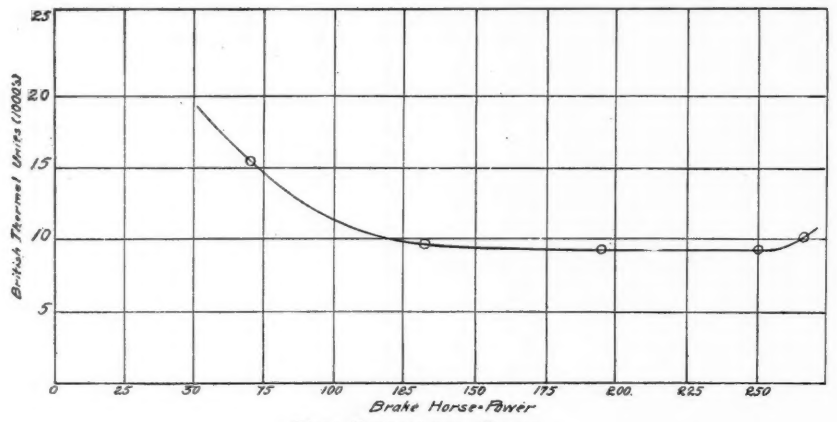
The electrical equipment consists of two Westinghouse type CCL motors of fifty-horse-power capacity each, which are belted to line shafting that in turn drives various machines. This is only one of the many instances where progressive companies have shown appreciation of the superiority of electric drive that led to its adoption.



Two Fifty-Horse-Power Westinghouse, Type CCL Motors, in Plant of the Springfield Metallic Casket Company, Springfield, Ohio.

Diesel Oil Engine Test.

The accompanying table and diagram are taken from a report on a 225-brake-horse-power Diesel oil engine installed at the plant of the Kimberly & Clark Paper Company, Kimberly, Wis., recently tested by the Sargent Engineering Company, Chicago, Ill. The plant consists of four Diesel engine units, one a 450-brake-horse-power engine (formed by coupling the shafts of two 225-brake-horse-power engines), coupled to a 300-kilowatt, alternating-current generator, two units of 225 horse-power, each connected to a 150-kilowatt, alternating-current generator, and one unit of 120 brake-horse-power to drive the high-pressure compressors used for starting and injecting fuel oil. All engines run in parallel with each other and with water-wheels. The plant was installed as an auxiliary to the water power, and is used when there is not sufficient water to operate the mills.



HEAT CONSUMPTION CURVE.

An examination of the diagram and table herewith will show some interesting features. The diagram particularly shows the low heat consumption per brake-horse-power-hour, and also the manner in which the fuel consumption follows the load from quarter to half, and from half to full load. In the diagram the abscissæ represent the brake-horse-power developed, the ordinates representing the British thermal units in thousands per horse-power-hour.

	Quarter Load	Half Load	Three-Quarters Load	Full Load	Over-Load
Date of run	1-5-'06	1-5-'06	1-5-'06	1-13-'06	1-13-'06
Length of run in hours	1.0	2.0	2.0	4.0	0.75
Revolutions per minute	179.1	177.1	174.5	169.1	161.2
Brake horse-power	68.15	133.7	194.9	249.7	263.8
Electrical horse-power	54.5	113.6	170.6	224.8	237.5
Kilowatts	40.7	84.8	127.3	167.7	177.2
Pounds of fuel oil used in main engine per hour	42.75	57.1	82.5	106.37	126.66
Pounds of fuel oil used in compressor unit per hour	40.5	35.6	35.87	38.93	38.33
One-quarter oil used in compressor unit per hour	10.12	8.9	8.97	9.73	9.58
Total pounds of fuel oil used per hour.	52.87	66.0	91.47	11.61	136.24
Pounds of fuel oil used per brake horse-power	0.776	0.493	0.469	0.464	0.516
Pounds of fuel oil used per electrical horse-power	0.97	0.580	0.53	0.516	0.573
Pounds of fuel oil used per kilowatt-hour	1.29	0.778	0.718	0.69	0.77
Pounds of jacket water per hour	2,033.5	2,528.3	3,324.0	3,894.5	5,306.0
Pounds of jacket water per brake-horse-power-hour	29.5	18.9	17.1	15.6	20.1
Average temperature inlet water	34.0	34.0	34.0	38.8	40.0
Average temperature outlet water	126.6	135.5	137.9	180.0	170.0
British thermal units per brake-horse-power-hour	15,103.0	9,594.0	9,127.0	9,029.0	10,041.0
British thermal units per electrical-horse-power-hour	18,877.0	11,287.0	10,314.0	10,041.0	11,151.0
Thermal efficiency of engine and dynamo, 2,545 British thermal units per electrical horse-power	13.4	22.5	24.6	25.3	22.8
Thermal efficiency of engine, 2,545 British thermal units per brake horse-power	16.8	26.4	27.8	28.1	25.3
Percentage British thermal units in water jacket	18.2	20.0	19.5	24.3	26.0
Percentage British thermal units in exhaust radiation and engine friction	65.0	53.4	52.7	47.6	48.7
Percentage British thermal units in brake horse-power	16.8	26.4	27.8	28.1	25.3
Pounds of oil per 100 brake-horse-power-hours	77.6	49.3	46.9	46.4	51.6
Gallons oil per 100 brake-horse-power-hours	10.5	6.7	6.4	6.3	7.0
Gallons oil per 100 kilowatt-hours	17.6	10.6	9.8	9.4	10.5
Fuel cost of 100 brake-horse-power-hours in cents with oil at 3.64 cents per gallon	38.6	24.5	23.3	23.0	25.6
Fuel cost of 100 kilowatt-hours	63.0	38.5	35.6	34.2	38.2

Referring to the table, the final data show that the fuel cost of this plant with crude oil at 3.64 cents per gallon is twenty-three cents per 100 brake-horse-power-hours at full load, and thirty-four cents per 100 kilowatt-hours. This engine is sold under a guarantee to deliver 100 brake-horse-power-hours on eight gallons of crude or fuel oil, and 100 kilowatt-hours on twelve and one-quarter gallons.

The New Plant of the H. T. Paiste Company

The H. T. Paiste Company, Philadelphia, Pa., has recently moved into a new factory building containing five stories and basement, 50 by 120 feet, with 30,000 square feet of floor space. H. T. Paiste established his present business in 1887, manufacturing at that time the Paiste switch, which was one of the pioneer snap switches made in this country. Other articles were added to the line, until at the present time the company is manufacturing 400 distinct articles entirely in the line of electric lighting supplies. The company was incorporated in 1894.

In the new building the power plant consists of a ninety-horse-power Coatesville boiler and a sixty-horse-power Ball engine direct-connected to a thirty-five-kilowatt Westinghouse direct-current generator. The electric plant was installed by the D'Olier Engineering Company, of Philadelphia. The different groups of machinery are driven by motors located on the several floors.

The factory has been laid out so as to be as convenient and up to date as possible. Special attention has been given to attractive features, and every effort has been made to create a factory which would attract the highest grade of employés.

A number of the patented Paiste products have become very well known, such as "Holoshade" sockets, panelettes, taplets, Fielding receptacles, "Pushin" attachment plugs, and the standard line of sockets, rosettes, receptacles and cutouts.

The officers of the company are: H. T. Paiste, president and treasurer; Charles I. Hills, vice-president; E. A. Jenkins, secretary.

The company has sales offices and warerooms located in New York, in charge of C. I. Hills; in Boston, in charge of Frank Booth, and in Chicago, in charge of James Wolff.

Portable Car Telephones.

The accompanying illustrations show some of the apparatus included in a line of portable car telephones which has been developed by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Realizing the possibilities of rough usage to which apparatus for this service may be subjected, the company has taken especial care to make all parts heavy and durable, and for that part of the equipment which may be placed out-of-doors and subjected to exposure, special attention has been given to protection both from the elements and the possibility of mechanical injury.

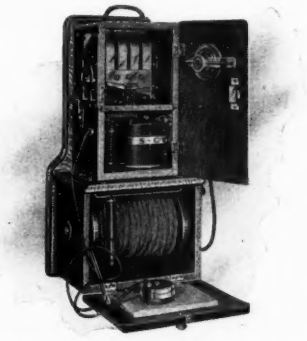


FIG. 1.—RAILWAY TELEPHONE.

Fig. 1 shows an instrument as it would be hung in the motorman's cab of an interurban car. The upper portion or portable part of the instrument is shown removed. This portable portion contains all of the apparatus necessary for telephone communication, the lower part of the telephone set containing a cabinet in which are mounted upon a reel a flexible cord and plug. When the upper or telephone box is in place it is connected to the cord in the reel in the bottom box through contact plates on top of the reel box, which make contact with buttons in the bottom of the telephone box. The object of the reel of cord is to enable connection to be made with plug receptacles on the pole near the car. The cord terminates in a plug similar to the plugs used in telephone exchange switchboard work, this plug, however, being made much larger and heavier. There is a guide for the cord as it is wound on the reel and a crank on the outside of the reel box for winding up the cord.

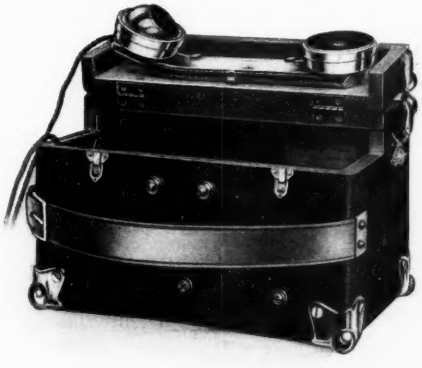


FIG. 2.—PORTABLE TEST SET.

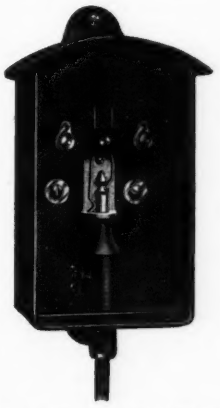


FIG. 3.—IRON-CLAD JACK-BOX.

The receiver is of the watch-case type, and when not in use fits in a receptacle which operates like the usual receiver hook switch to cut out the transmitter when the instrument is not in use. The portable part of the instrument, or telephone box, has a plug and short cord attached to it for use when the telephone is used on the line away from the car.

Fig. 2 shows a portable test set which forms an important part of this equipment, and Fig. 3 an iron-clad jack-box for use in exposed positions. Fig. 4 shows how connections may be made with the telephone wire alongside the track where no jack-box is handy.

FIG. 4.—METHOD OF CONNECTING TO AERIAL.

Linemen's Portable Telephone-Testing Sets.

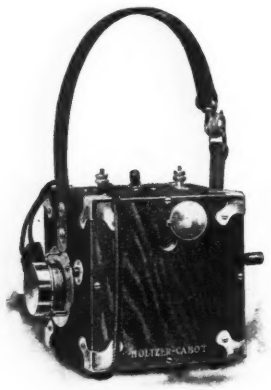
The Holtzer-Cabot Electric Company, of Brookline, Mass., and Chicago, Ill., has recently developed and placed upon the market two types of portable testing sets for linemen's use. These are known as the "Universal" and "watch-case receiver" types, description of which is given in the following:

The "Universal" type of testing set was designed to meet the practical requirements of telephone linemen and contains many novel features which should commend themselves to users of this class of apparatus. It embodies everything required in all classes of telephone line testing, thereby doing away with the necessity of having separate sets for series and bridging work. The case is substantially made, protected by metallic corner shields, and is provided with a carrying strap which has a snap-catch so that the box may be quickly suspended from the cross-arm or any projection by the use of one hand. The door is held closed by an automatic catch, which is released by a flush pushbutton, preventing the case being accidentally opened. This set is provided with a hand microtelephone, which combines the Holtzer-Cabot binolar watch-case receiver and standard granular carbon transmitter. This instrument enables the lineman to talk in any position that he may be, as it may be taken from the box and the door closed. This feature has an advantage over the testing sets in which the transmitters are mounted on the cover. The mouthpiece is metallic so that it will withstand hard usage, and in the handle there is a pushbutton which throws

"UNIVERSAL" LINEMEN'S PORTABLE TELEPHONE TEST SET.

the batteries out of circuit when not in use, thus prolonging their life. Three or four-bar generators of the magneto type are furnished as desired. They give alternating current for signaling subscribers, or pulsating direct current for ringing the switchboard; this is controlled by a two-point switch inside the cover. There is also a pushbutton to shunt out the ringer on heavily loaded lines. Each set is equipped with a standard 1,000-ohm ringers, which may be shunted out of circuit when desired by means of the pushbutton. The induction coil is of the standard square-head type, with a resistance of 100 ohms. Two dry batteries are used. The binding posts are conveniently located on the top of the case and may be manipulated by one hand without a screwdriver or tool of any kind.

For certain classes of testing, sets of the receiver type have become popular with linemen, and on account of several practical features which are embodied in the latest model placed on the market by the Holtzer-Cabot Company, an increase in the demand for this article is expected.



Receiver Type Telephone Testing Set.

The essential features of this set correspond closely to the "Universal" type. The case has protected corners and a carrying strap furnished with a clasp so that the box may be quickly suspended. The receiver is of the watch-case, bipolar pattern and is used for both talking and listening. A valuable and essential improvement is the addition of a pushbutton in the receiver. This button normally keeps the receiver circuit open, but upon pressing it the circuit is closed. Thus while communication is established the button is held closed by the thumb of the operator, but as soon as the conversation is through the receiver may be laid down and the circuit is automatically opened.

The receiver is wound to 150 ohms and is enclosed in a metal case, making it a substantial instrument for outdoor use. The generator is equipped with combination spring and two-point controlling switch, enabling it to give alternating or pulsating direct current for signaling the subscribers or the central switchboard. The resistance of the ringer is 1,000 ohms, and it may be shunted, if desired, when used on a heavily loaded line. This set has been carefully designed and meets the various requirements of line testing where the more elaborate set is not necessary. It is equally serviceable on both series and bridging circuits.

A New Lamp Guard.

The accompanying illustrations show a new lamp guard recently placed upon the market by Harvey Hubbell, Incorporated, Bridgeport, Ct. The principal features

Fig. 1.—Wire Lamp Guard and Collar.

of this guard are simplicity and strength, the rigid way in which it is fastened to the socket shell, and the ample space between the outside of the guard and the lamp.

Fig. 1 shows a contractile collar and an internal thread in the top of the guard. When attached to the socket the collar is placed over the rib of the socket shell,

Fig. 2.—Guard Attached to Lamp.

then the guard is screwed on. This causes the collar to contract and hug the rib on the shell, making an absolute lock, and holding the guard securely against the socket shell.

Fig. 2 shows the guard attached to the socket. The connection is made close to the neck of the lamp, giving rigidity where it is needed. There is plenty of space between the lamp and the guard, and the opening at the bottom is sufficiently large to insert the lamp. The rigid support given to the guard prevents the

Fig. 3.—Guard Fitted with Shade.

lamp bulb from coming in contact with the guard.

Fig. 3 shows the guard fitted with a Hubbell shade.

The wire from which these guards are made is selected from heavy stock, and, owing to the unique method of fastening, very little metal is required; consequently there is comparatively little obstruction to the light. These guards are made for both sixteen and thirty-two-candle-power lamps.

Cook's Automatic Electrical Testing and Resetting Plug.

Frank B. Cook, Chicago, Ill., has placed on the market a new device designated as an automatic electrical testing and resetting plug for application to Cook's No. 8 protector. This device is designed to obviate the possibility of resetting self-soldering heat coils when they are not in condition to give protection to the system.

Occasionally, large currents passing through the heat coils overheat and short-circuit them by charring the insulation on the winding, by fusing together, or bringing into contact with each other certain parts of the heat coil. A short-circuited coil may be replaced in the circuit which it is to protect, but it will not heat enough to operate the apparatus. In the ordinary testing of a telephone line there is nothing to indicate that the heat coil is short-circuited, as the circuits is completed and the line seems to test O. K. In order to give greater protection to the system and to determine whether a heat coil is short-circuited or not, this testing and resetting plug has been designed.

Current Electrical News

DOMESTIC AND EXPORT.

GREAT WESTERN POWER COMPANY—The Great Western Power Company, of Point Richmond, Cal., composed of a coterie of wealthy men of Contra Costa and Alameda counties, have filed articles of incorporation with a capital stock of $25,000,000, divided into 250,000 shares. W. S. Rheem, one of the directors of the East Shore & Suburban Railroad Company, of Point Richmond, is a leading factor in the enterprise, while associated with him are: Guy C. Earl, of Oakland; W. H. Spaulding, of Oakland; H. G. Young, E. A. Gowe, W. Stairley and L. D. Dimm, of Richmond; F. D. Madison, of San Rafael, and B. C. Carroll, of Oakland.

GRAND RIVER, COLORADO, TO SUPPLY DENVER WITH POWER—A despatch from Springfield, Ohio, states that ex-Governor Herrick is at the head of a $10,000,000 company organized to develop Grand river power in Colorado for the cities of Denver, Leadville, Colorado Springs and Cripple Creek. Particulars of the project are lacking, but it is understood that there will be electric plants built along the Grand, and the power transmitted to the above-named cities at a cheaper rate than they are now getting for light and other purposes. Smaller towns along the way are to be supplied as soon as the company can make sufficient provision for creating the necessary power.

NEW OHIO RAILWAY PROJECT—John G. Webb, George Holzberg, H. H. Harris, James S. Webb and George Whysall, all prominent traction men, have incorporated the Marion & Western Railway, Light and Power Company, of Columbus, with an authorized capital stock of $2,000,000. The new company is controlled by the same interests which own the Columbus, Delaware & Marion, and will construct a line from Prospect, on the Columbus, Delaware & Marion, to Richwood, Union county. The distance is but a little more than seven miles, and the road will tap one of the best sections of the state. Richwood has but one railroad, the Erie, and has long been trying to get a traction communication.

EXTENSIVE TELEPHONIC IMPROVEMENTS FOR LOS ANGELES—Plans that call for the expenditure of $1,000,000, and the installation of a complete automatic telephone service throughout the city have been adopted by the stockholders of the Home Telephone Company, of Los Angeles, Cal. President J. M. C. Marble, who has been one of the guiding spirits in the formation of the company, has resigned, owing to press of business, and A. B. Cass, vice-president, elected president. Mr. Marble remains on the directorate of the company. W. C. Patterson, a director, is elected vice-president, succeeding Mr. Cass. The company will build two new stations, one at Olive street, below Seventh, and one on Adams street. These will have an aggregate capacity of 35,000 telephones, and will be sufficient to accommodate the needs of the company for several years. Both of these stations are to be in operation by the first of the year. Arrangements are to be made during the coming year by the Home company for connections with the United States Long-Distance Telephone Company, of San Francisco and Oakland, which will give service from all of the Home lines in this vicinity to the northern cities. The statements made at the meeting of the stockholders showed that the concern has expended for equipment a total of $4,465,000.

NORTH GEORGIA ELECTRIC COMPANY FILES LARGE MORTGAGES—The North Georgia Electric Company, of Gainesville, has filed with the clerk of the Superior Court a first and refund mortgage to the Knickerbocker Trust Company for $7,500,000. The bond issue was authorized at a meeting of the stockholders which was held in Atlanta on August 25. It was voted by 7,951 of the 8,637 shares. The bonds are to mature at the end of fifty years, and are to bear interest at the rate of five per cent a year, payable semi-annually, and are to be secured by the mortgage on the company's property which has just been filed. The object of the bonds is to equip the company's general business; to put it in a position to contract for and build and equip electric railways and electric plants; to sell power and light to private and municipal corporations and to the general public and to establish waterworks. The company has water power in the Chestatee river and the Chattahoochee in Heard county, and the Etowah near Cartersville, and also in Cherokee county. It is proposed to have a plant in or near Atlanta, where power may be distributed to Fulton and De Kalb counties. Of the bonds, 2,500 are to be $1,000 denomination each; 5,000 of $500 each, and 25,000 of $100 each. The mortgage is signed by A. J. Warner, of Gainesville, president of the North Georgia Electric Company, and B. L. Allen, third vice-president of the Knickerbocker Trust Company.

MERGER OF OHIO TRACTIONS—The Canton-Akron Railway Company, the Canton-New Philadelphia Traction Company and the Tuscarawas Traction Company, all controlled by the Tucker-Anthony syndicate, of Boston, Mass., passed out of existence on September 29 when the formal transfer of the properties was made to the Northern Ohio Traction and Light Company. General Manager Currie, of the Northern Ohio, will be general manager of the entire system. Preliminary to the merger the Northern Ohio company, at a recent meeting, increased its capital stock from $7,500,000 to $10,000,000, that being one of the first movements required. Of this new stock, $1,038,000 will be issued to take over the common stock of the Canton-Akron. The other details are being worked out according to the original plan, the Canton-Akron Consolidated Railway increasing its capital to $2,500,000 and the same amount of bonds being put out. This stock and the bonds will be used for the purpose of taking over the stocks of the absorbed companies and for retiring the underlying bond issues when due. The Northern Ohio assumes the interest on the bonds. As soon as possession has been obtained, through service over the entire system will be started and travel by through cars will be possible from Cleveland to New Philadelphia. The Northern Ohio upon the merger controls the principal line in Summit, Cuyahoga, Wayne, Tuscarawas, Stark and Medina counties. It also operates lines in all the principal cities and villages in these six counties, with Akron as a centre of operation.

ELECTRIC LIGHTING.

HOVILLA, GA.—F. E. Bailey is installing an electric light plant.

MILWAUKEE, WIS.—The common council has voted $50,000 from the $150,000 light bonds to purchase an electric light plant site.

READING, PA.—The Mahanoy city council has awarded the contract for street lighting for ten years to the People's Light, Heat and Power Company at $60 per arc lamp.

WILMINGTON, DEL.—It has been reported that work will be started in a short time on the proposed plant of the Commercial Light, Heat and Power Company, and that a large force of men will be put to work.

ATLANTA, GA.—Capitalists from this city have made a proposition to the authorities at Americus, Ga., looking to the establishment of power, gas and electric plants in that city, and also the building of a street railway.

SHERBROOKE, QUEBEC—At a meeting of the city council a resolution was passed instructing the city engineer to prepare plans and specifications for a dam and electric power plant on the Magog river, about six miles from Sherbrooke.

PHILADELPHIA, PA.—A large dam on Blue Mountain will be constructed, at a cost of $8,000, to furnish power to operate an electric light plant, which will supply power and light to Bethel, Millersburg, Strausstown and Rehrersburg.

TOPEKA, KAN.—The Topeka Electrical Company has begun the work of laying conduits in the down-town district of the city.

A site will be selected and the company's plant erected before December 1. The company hopes to begin operations on January 1.

ROCHESTER, N. Y.—Mayor Cutler has signed the new lighting contract with the Rochester Railway and Light Company, to take effect July 1, 1907. By its terms the Mayor has secured a reduction of $20 per lamp, amounting to a total saving to the city in five years of about $300,000.

ORANGE, N. J.—The Orange common council has practically decided to receive bids for a municipal lighting plant on October 25. A form of proposal was considered, calling for bids for three engines and electric generators, switchboard poles, wires and equipment for 350 arc lights.

LOCKPORT, N. Y.—The common council has approved the proposition of the Lockport Gas and Electric Light Company to furnish arc lights to the city for three years at $55 each per year, and gas to all consumers at $1 per 1,000 cubic feet. The present prices are $75 and $1.30, respectively.

WATERTOWN, N. Y.—The chamber of commerce has adopted a resolution favoring the consolidation of the Watertown Electric Light Company, the Watertown Gas Light Company, and the Remington Pulp and Paper Company, into the Watertown Light and Power Company, with a capitalization of $2,300,000.

FRANKFORT, N. Y.—At a special meeting of the town board of the town of Frankfort and commissioner of highways, a consent was granted the Hudson River Electric Power Company, allowing it to use the right of way owned by the Utica & Mohawk Valley railway through the town for its transmission line.

MANCHESTER, N. H.—The Berlin-Shelburne Power Company has been newly organized to take over the electric plant constructed this season at the Lead Mine bridge in Shelburne. The incorporators are: E. A. Noyes and Edmund Woodman, of Portland; Edmund Sullivan, O. B. Brown and J. P. Dubey, of Berlin.

GRAYVILLE, ILL.—The city of Grayville now owns the water and light plant, having purchased it from the Grayville Water Works Company. The purchase price was $10,000, of which amount $3,500 was paid in cash and bonds to the amount of $6,500 issued. The city will make improvements to the plant and give an all-night service.

BROWNSVILLE, TEX.—The city council has granted a franchise for the construction of a waterworks and electric light plant. The grantee is the Brownsville Water, Light and Power Company, composed of local capitalists, who have pledged themselves to take $25,000 stock in the concern. The plant will cost nearly $100,000. Work must begin in three months.

CINCINNATI, OHIO—Attorney Louis Dolle has received fifty additional deeds from owners of property adjoining the Little Miami river, consenting to the location of dams, to be used in connection with an electric plant which will furnish light, heat and power to the villages northeast of Cincinnati. Mr. Dolle also has the consent of owners to employ 148,000 feet of abutting land which will be used in connection with the improvement.

ELK RAPIDS, MICH.—The common council has granted an electric light franchise to William E. Donley of Big Rapids. The franchise is to run for a period of ten years and the plant will be operated on a moonlight schedule. There will also be a morning service from 5 to 7 A. M. from November 15 to February 15, a period of three months, each year. The village let a contract for twenty-five arc lights to cost $75 per year each. Additional arc lights will be furnished at a cost of $70 per year each.

HYATTSVILLE, MD.—A meeting of the mayor and town council was held on September 24, when the mayor on behalf of the council, signed a contract with the Potomac Electric Power Company, of Washington, to furnish electricity for ten years for lighting the streets of Hyattsville. It is expected that the plant will be installed before winter weather arrives. The company is to furnish not less than 100 incandescent lamps of thirty-candle-power each at $12 a year, and such number of arc lamps as may be ordered by the town at $65 each a year.

MARINETTE, WIS.—F. H. Joslin and other Oshkosh parties have closed a deal for the purchase of two water powers on the Peshtigo river at High Falls and Joslin Falls. The consideration was $50,000. The Oshkosh capitalists will develop both powers and transmit the power to Marinette and Green Bay. A power company will be organized, as the project will necessitate the expenditure of several hundred thousand dollars. This will be the only transmission power project in the vicinity. The distance to Marinette is thirty miles and to Green Bay fifty miles.

ST. LOUIS, MO.—It is announced that the King Electric Company which has a franchise in St. Louis county, has been purchased by A. C. Einstein and Paul D. Cable, owners of other lighting plants in the county. Mr. Einstein stated that the property had been bought by him for about $100,000. The King Company has a plant at DeHodiamont and has been for some time the only company operating in the county. The General Service and Development Company formerly owned a plant at Brentwood, which supplied light to Webster Groves. This was recently torn down. The same interests which bought the King Company property now own all the lighting franchises in the county.

GLENS FALLS, N. Y.—After dragging through the courts for several years, the suit of the National Contracting Company, of New York city, against the Hudson River Water Power Company, for damages growing out of the connection of the construction company with the building of the two-million-dollar dam across the Hudson river at Spier Falls, has finally been decided by former Judge Alton B. Parker, who holds that instead of the power company owing more than $600,000 to the construction company, the latter shall pay $383,000 damages to the power company for abandoning their contract and causing the power company almost half a million dollars extra expense. The decision is sweeping and carries with it costs.

COVINGTON, KY.—Owen Ford, of St. Louis, electrical engineer, has made an estimate of the cost of operating and maintaining an electric light plant, and says the city can save money by making its own light for street and public buildings. His estimate, which was received a short time ago, shows that the city can make electricity sufficient to supply about 400 arc lights of 2,000 candle-power each at $54.80 per light per year. This estimate is made on a plant built in accordance with the plans and specifications recently prepared for the city by Mr. Ford, which made provision for from 400 to 500 arc lights of 2,000 candle-power and 2,000 incandescent lights. The cost of this plant, according to his estimate, would be about $106,000. The city is now paying $65 a year for arc lights of about 1,250 candle-power. It is estimated that by building and operating its own plant, according to the figures of Mr. Ford, the city could save approximately $5,000 a year.

NEW MANUFACTURING COMPANIES.

CAMDEN, N. J.—The Fraley Developing Company has been incorporated to manufacture electrical and mechanical devices. The capital is $150,000, and the incorporators are: F. R. Hansell, William F. Eidell and I. C. Clow.

CHICAGO, ILL.—The Universal Lock Socket Company has been incorporated with a capital of $2,500, to manufacture and deal in electrical apparatus. The incorporators are Clayton R. Taylor, William M. Klein and O. P. Lightfoot.

PORTLAND, ME.—The Jackson Clock Telephone Company has been organized at Portland for the purpose of manufacturing and dealing in electrical apparatus. The company has a capital of $1,000,000, and the following are the officers: President, Hayes Lougee, Boston, Mass.; treasurer, John G. Robinson, Melrose, Mass.

HARTFORD, CT.—A certificate of incorporation has been filed by the Gillette-Wibber Company, of New London. The company will conduct a general electrical business. The amount of authorized capital stock is $20,000, divided into 200 shares of the par value of $100 each, and the company will start business with that amount paid in.

ALBANY, N. Y.—The Baldinger & Kupferman Manufacturing Company, of Brooklyn, has been incorporated with the secretary of state to deal in electric light fixtures, etc. The capital stock is placed at $50,000, and the directors for the first year are as follows: Louis Baldinger, Oscar Kupferman and Henry Bonawitz, of Brooklyn.

NEW INCORPORATIONS.

COLUMBUS, OHIO—Mansfield & Southern Traction Company. Increased from $1,000 to $250,000.

READING, PA.—West Reading Power Company. $25,000. Incorporators: Walter A. Rigg, Milton Miller and Harry H. Reigel.

CONCORD, N. H.—Derry & Goffs Falls Street Railway Company. $50,000. To build a line from the new Goffs Falls & Hudson road to Derry.

MADISON, WIS.—The Marathon City Telephone Company, Marathon City. $1,920. Incorporators: Nicholas Schmidt, J. G. Lang and H. B. Stemm.

ALBANY, N. Y.—New York Electric Installation Company, New York. $20,000. Directors: T. J. Hogan, Julia C. Hall, and James P. Law, New York.

SPRINGFIELD, ILL.—Harrisburg Independent Telephone Company, Harrisburg. $2,500. Incorporators: John T. Wheatley, W. D. McIlrath and P. H. Brown.

MADISON, WIS.—The Edgar Local Telephone Company, village of Edgar, Marathon county. $2,000. Incorporators: C. C. Barrett, A. W. Putchner and A. J. Cherney.

DENVER, COLO.—Walsenburg Light, Power and Ice Company. $40,000. Directors: William Dick, D. W. Mathews, Antonio Bertolaro, John J. Pritchard and Fred Roof.

SALEM, ORE.—Municipal Water and Light Company, of Roseburg. $5,000. Incorporators: E. V. Hoover, Joseph Nicelli, F. M. Beard, J. W. Wright and A. N. Orcutt.

NEW ORLEANS, LA.—St. Bernard Traction Company. $300,000. Directors: W. J. Kelly, M. Warrines, R. H. Warrines, Henry P. Dart, Oliver P. Livaudais and L. T. Bringier.

COLUMBUS, OHIO—The Haverhill Telephone Company, Scioto county. $2,500. Incorporators: O. E. Insh, A. S. Goodard, W. A. Brush, H. J. Massie and Henry Folsom.

SANTA FE, N. M.—Reliance Electric and Construction Company, Albuquerque. $20,000. Incorporators and directors: M. K. Wyler, H. Bartlett, R. Hicks and J. P. Steele, of Albuquerque.

PIERRE, S. D.—Beaver Bend Telephone Company, Valley Springs, Minnehaha county. $1,000. Incorporators: J. H. Johnson, Ferdinand Larson, H. C. McGilvery, August Anderson.

CHEYENNE, WYO.—Newcastle Electric Company. To operate at Newcastle, Wyo., and control the electric light plant at that place. $30,000. Incorporators: George E. Getchell, W. E. Mouck and J. L. Baird.

PIERRE, S. D.—Pleasant View Telephone Company. To erect a rural line in Lincoln township, Lincoln county. $1,200. Incorporators: Homre Denure, J. F. Hunt, Otto Johnson, of Lincoln township.

DENVER, COL.—The Windsor Light and Power Company, Windsor, $10,000. Incorporators: William J. Barber, William F. Crossler, Harrison Teller and Frank E. Bonifield.

LANCASTER, PA.—Columbia & Manor Street Railway Company. $102,000. Directors: William Morris, Columbia, president; Joseph K. Shultz, Henry Wertz, H. H. Herr, Frederick Shoff, H. M. Kauffman, D. H. Landis, Jacob M. Linderman, E. K. Hershey.

ALBANY, N. Y.—The Indian Fields Telephone Company, of Westerlo. Directors: P. R. Whitbeck, W. B. Lester, C. R. Whitbeck, A. C. Coons, G. E. Dickenson, A. D. Caldwell, Daniel Snyder, W. Udell, of Indian Fields, and R. J. Houck, of Keefer's Corners.

ALBANY, N. Y.—The Mountain Home Telephone Company, of Saranac Like. To operate in the counties of Franklin, Clinton, St. Lawrence, Jefferson, Lewis, Hamilton and Essex. $150,000. Directors: Howard Hendrickson, William A. Hendrickson, Henry M. Keys, Frank E. Griffin, William B. Harris, Henry J. Prince, Jr., Frank E. Derr, of Albany.

HARRISBURG, PA.—Midway & Burgettstown Street Railway Company. To build a line six and a half miles long in Washington county, between the boroughs of Midway and Burgettstown. $37,000. Charles V. Dahlinger, Pittsburg, president. Directors: Charles W. Dahlinger, Pittsburg; John W. Thomas, Sharpsburg; V. A. Powel and J. B. Flack, East Pittsburg, and L. W. Bigham, Pittsburg.

SALT LAKE CITY, UTAH—Light, Power and Water Company. Formed for the purpose of diverting certain of the waters of the Green river for power and irrigation purposes. $24,000. Principal place of business, Elgin, Grand county, Utah. Officers: L. P. Hill, president; W. G. English, vice-president; W. A. Morgan, secretary; C. E. Whisler, treasurer and general manager. Directors: J. F. Ewing, F. L. Cottrell, J. N. Powers and the officers.

TELEPHONE AND TELEGRAPH.

UTICA, N. Y.—The Bell Telephone Company has established an exchange at Barneveld.

ROCHESTER, N. Y.—The entire issue of $2,500,000 of two-year six per cent collateral notes of the United States Independent Telephone Company, has been subscribed for.

AMHERST, VA.—R. T. Seay, of this place has bought the Amherst Telephone Company, and has made a contract with the Bell Telephone Company, whereby he will be able to give long-distance connections.

KEYSER, W. VA.—A new telephone company will operate a line from Keyser to Petersburg, by way of Burlington, up Patterson's creek, with lines into Virginia. J. W. Carskadon is president and J. W. Wagoner is secretary and treasurer.

ROCK HILL, S. C.—Preparations are being made for improving the local telephone system. A new switchboard will be installed, and sixty-foot poles erected on the principal streets. It is hoped to have the work completed by the first of the year.

GLENDALE, OHIO—The Glendale telephone exchange is nearing completion. A new 500-line switchboard has been installed in the company's new quarters, and a double force of operators will be employed as soon as the exchange is ready to receive them.

TOLEDO, OHIO—To better handle its business here, the Central Union Telephone Company will erect a four-story concrete building to be used for a branch exchange. The building will be 40 by 100 feet in dimensions. It will cost between $25,000 and $30,000.

BROCKTON, MASS.—Brockton has been made the headquarters of the first of two districts into which the southern Massachusetts telephone system is being divided. About November 1 the second district will be organized, it is expected, with headquarters at New Bedford.

MARQUETTE, MICH.—The Marquette Telephone Company, an independent concern operating in the three cities and several villages of the county, has voted to increase its capital stock from $60,000 to $100,000. The new capital will be used for improving the system.

WINNFIELD, LA.—A telephone exchange will be put in at Jena, forty miles east of here on the Louisiana & Arkansas Railroad. O. E. White is at the head of the enterprise. A line will be run from Jena eastward to Jonesville, where it will connect with the Cumberland system.

ST. JOHNSVILLE, N. Y.—The contract for the contemplated extension of the Interstate telephone lines to Crown Creek and Oppenheim has been let to George Reese, of Crown Creek, who will begin the work immediately. The Interstate extension to Stark is completed and the immediate extension of the system from Canajoharie is also in contemplation.

BONO, ARK.—The farmers in the vicinity of Bono have organized a mutual telephone company and have elected W. B. Broom president; Riley Stichham vice-president, George A. Lamb treasurer, and P. R. Barnes secretary. There are thirty subscribers and the switchboard and telephones have been ordered. The line will be built at once, and the central office will be at Bono.

ELECTRIC RAILWAYS.

ANN ARBOR, MICH.—An electric line to Whitmore Lake and from there to Lakeland is projected by an Ann Arbor capitalist.

NASHUA, N. H.—The Hub Construction Company has begun the construction of the Goffs Falls, Litchfield & Hudson electric railroad in Hudson.

EAST DOUGLAS, MASS.—The contract for building the proposed Worcester & Providence street railway has been given to Pepper & Bowie, engineers and contractors, of Philadelphia.

LIMA, OHIO—The Schoepf system has opened its new Lima and Toledo trolley road for regular service north as far as Ottawa, and put on a bi-hourly service temporarily. It is announced the road will be completed into Toledo by spring.

OSCEOLA, IOWA—The promcters of the Des Moines, Winterset & Creston interurban road have enlarged their plans and now propose to extend a branch of the road from Winterset to Osceola and inaugurate a fast service between Des Moines and Osceola.

SPOKANE, WASH.—J. H. Morrow, general manager of the Columbia & Walla Walla Traction Company announces that the company has secured all the right of way in the Walla Walla Valley and that a line of 104 miles will be ready for operation the coming year.

SPOKANE, WASH.—Jay P. Graves, president of the Inland Empire Railway Company, announces that the line will be extended down the Spokane river to the power plant at Nine Miles Bridge, where a 9,000-horse-power plant is under construction, under the supervision of A. L. Zimmerman, of Philadelphia.

WEBSTER CITY, IOWA—At a special election held in this city to-day, the Boone, Webster City & Interurban Railroad Company was granted the right to operate cars on the streets, and to maintain an interurban service between Boone and Webster City. A five-year remission of taxes was also granted.

TRAVERSE CITY, MICH.—L. K. Gibbs, president of the Traverse City & Old Mission Electric Railway, has received word from his attorney in New York that the contract for constructing an electric railway from Traverse City to the Old Mission summer resort had been closed. It is believed work will be begun shortly.

SHARON, PA.—The right of way for a trolley line from Mahoningtown to Morada Park has been secured, and plans for the line are under consideration. With the completion of this line there will be nearly a complete system between Sharon and Pittsburg. This will give a line through Youngstown to Cleveland, Ohio.

BAKER CITY, ORE.—David Eccles, of Baker City, has taken over the construction of the Eagle Valley electric railway and will build a line, construction work beginning in October. Residents of Baker City have subscribed $100,000 toward the project which will be operated in connection with the Sumpter Valley electric railway.

SACRAMENTO, CAL.—Louis F. Hanchette, John Martin, Eugene de Sabla and their associates have commenced work on their Santa Clara interurban electric road. It is to run from the town of Santa Clara north to San Mateo via Palo Alto. Connection will be made with the San Jose and Santa Clara system, which is owned by the same people.

WALLA WALLA, WASH.—Representatives of the Walla Walla Traction Company have secured an additional right of way to Freewater, Ore., southwest of Spokane, where a terminal site has also been secured. Work on the line between Walla Walla and Freewater is progressing and the company expects to have cars in operation early in December.

UTICA, N. Y.—The annual meeting of the stockholders of the Utica & Mohawk Valley Railway Company was held at the company's office recently. The following directors were elected: Horace E. Andrews, John J. Stanley, John Carstensen, E. V. W. Rossiter, W. K. Vanderbilt, Jr., Walter N. Kernan, Charles B. Rogers, Nicholas E. Deveraux and James S. Sherman.

PHILADELPHIA, PA.—Bids have been invited by the Philadelphia & West Chester Traction Company for the erection of a brick and concrete car barn and repair shop at Llanerch. The building will be substantially fireproof, the walls of brick, the foundations and floors of concrete and the roof beams and post-supporting roof beams of steel-reinforced concrete. The dimensions will be 216 by 124 feet.

BOSTON, MASS.—The Boston & Northern Street Railway Company has filed with the railroad commissioners at Boston a petition for the approval of the terms of purchase of the Georgetown, Rowley & Ipswich Street Railroad Company, and of the Lowell & Woburn Street Railroad Company. The purchase of the first-named road will require the issue of $240,000 additional capital stock, and that of the latter $143,200.

TRENTON, N. J.—Negotiations have been concluded for the sale of the Philadelphia, Bristol & Trenton Street Railway to the Interstate Railways Company. The Interstate Company controls the Trenton Street Railway Company and the trolley systems in Chester, Wilmingtown, Wilkes-Barre, Reading and other places. John C. Rigg, of Reading, is its president. The Philadelphia, Bristol & Trenton road runs from Trenton to Torresdale.

SAN FRANCISCO, CAL.—The United Railways Investment Company of San Francisco has filed a certificate with the secretary of state of New Jersey to change the name of the corporation to the United Railways Investment Company, omitting the words "of New Jersey." The reason for the change, which has been approved by the stockholders, is that the company has acquired interests outside of San Francisco through the purchase of a majority interest in the stock of the Philadelphia Company, of Pittsburg.

PLAINWELL, MICH.—Options are being secured in this vicinity for the construction of an electric railroad from Augusta to Allegan by the way of Richland, Plainwell, Otsego and Allegan. The Commonwealth Power Company, which owns three big power dams between Plainwell and Allegan besides other dams in the state, is back of the enterprise. The road will connect at Augusta with the Kalamazoo & Battle Creek interurban. If built it will tap a good territory, a great portion of which is now without railroad facilities.

FORT DODGE, IOWA—The Northwestern Construction Company has let the contracts for the erection of five substations or powerhouses at Ankeny, Kelly, Fort Dodge Junction, Fraser and a place seven miles south of Fort Dodge, which is still unnamed. The contract calls for the completion of the stations seventy-five days from the twelfth of September. The substations are to be thirty-two feet square and about twenty-five feet high, and are to be built of fireproof brick. The main station at Fraser is to be ninety by ninety feet.

SPOKANE, WASH.—The Northern Pacific Railway Company announces that it will operate an electric railway over the old Union Pacific grade, between Portland and Tacoma, 145 miles, and the Willamette Valley Company has begun the construction of a line between Salem and Mehama, Ore., twenty-five miles. The United Railway Company will build 100 miles of line in and outside the city of Portland, Ore. The Oregon Water Power Company will extend its line from Lents to Trentsdale and establish a ferry over the Columbia river.

POTTSTOWN, PA.—The Schuylkill Valley Traction Company has obtained possession of the Pottstown & Northern trolley line, to be used as a link in its Reading-Philadelphia system. The sum of $28,000 was paid, and the present name of the road will be retained. George Hoeger, of Norristown, was elected president; Harry Rosen, of Reading, secretary, and Dr. Walter Rigg, of Reading, treasurer. Work has been begun extending the road from Ringing Rocks northward to Swamp, to connect with the Schuylkill Valley branch, which will complete the line to Reading.

NEW WESTMINSTER, BRITISH COLUMBIA—At a meeting of the Chilliwack Power and Light Company that company disposed of its entire electric railway rights to the British Columbia Electric Railway Company for $10,000. The principal right purchased was to build an electric railway line from New Westminster to Chilliwack, a distance of about seventy miles. The British Columbia Electric Railway Company has for over a year been endeavoring to secure this charter, but the price was considered too high for the rights that it represented. The early building of a line up the Fraser valley is assured, as plans are already under way for its construction.

PERSONAL MENTION.

MR. H. A. HARRIS, of the Automatic Electric Company, Chicago, Ill., was a New York visitor last week.

MR. E. B. KETTLE, manager of the Chicago office of the Sprague Electric Company, was a New York visitor last week.

MR. S. I. WALES, manager of the sales department of the National Brake and Electric Company, Milwaukee, Wis., was a New York visitor last week.

MR. C. O. BAKER, formerly of the Telluride Power Company, of Utah, has been appointed superintendent of the Telluride Electric Light and Power Company, of Telluride, Col.

MR. J. RICHARD SLOAN, electrician motive power department, Pennsylvania Railroad Company, with headquarters at Altoona, Pa., was a visitor to New York city during the past week.

MR. FRANK H. TAYLOR, formerly vice-president of the Westinghouse Electric and Manufacturing Company, has been elected vice-president of the Yale & Towne Manufacturing Company, New York city.

MR. JOHN H. DALE, of the Dale Manufacturing Company, New York, is making a long trip through Europe, combining a good deal of business with a little vacation and rest. Mr. Dale will return in about three months.

MR. C. H. BRISTOL, formerly of the advertising department of the Western Electric Company, Chicago, Ill., is now attached to the advertising department of the Electric Service Supplies Company, Plymouth Building, Chicago.

MR. ARTHUR JONES, president of the Arthur Jones Company, Chicago, Ill., has been in New York for ten days. His company represents the National Brake and Electric Company, of Milwaukee, Wis., and also the Mechanical Appliance Company, of Milwaukee, Wis.

PROFESSOR LUCIEN I. BLAKE, for many years the head of the Department of Physics at the University of Kansas, Lawrence, Kan., has recently taken charge of the laboratories of the Submarine Signal Company, of Boston, Mass. Professor Blake is one of the progressive men of the day, and has made a special study and devoted years of experiment to this branch of electrical work.

MR. VAN RENSSELAER LANSINGH, general manager of the Holophane Glass Company, is contributing a good deal to the educational campaign devoted to good illumination. Mr. Lansingh is down for a lecture before the American Gas Institute, Chicago, October 18, on the "Standardization of Incandescent Lamp Mantles," and lectured before the Boston Edison Company's meeting on Friday, October 12.

MR. LOUIS B. MARKS, the well-known consulting electrical engineer, has been retained as consulting engineer in illumination for the new Carnegie public libraries of New York city by Messrs. Carrere & Hastings, McKim, Mead & White and Babb, Cook & Willard, the advisory board of architects for Mr. Carnegie. This appointment makes a distinct departure in the practice of some of the leading architects of the country, and one which will probably go far toward establishing the claims of the illuminating engineer.

LEGAL NOTE.

SINGLE-PHASE MOTOR LITIGATION—Announcement is made that on September 19 Judge Hazel, sitting in the United States Circuit Court for the Southern District of New York, handed down a decision favorable to the Wagner Electric Manufacturing Company, St. Louis, Mo., in a suit of equity brought against it by the Arnold Monophase Electric Company, of Philadelphia, Pa. The patents involved are those of Professor E. Arnold, Nos. 543,836 and 562,365, and constitute a part of the chain of patents utilized in the single-phase power motors utilized by the Wagner company.

ELECTRICAL SECURITIES.

The dealings in the stock market last week showed a very apparent contraction, and the feeling is extant that whatever operations were conducted were largely of a professional nature. At the same time, the general price tendency has been upward, and compared with a week ago a number of leading industrials have made fairly good rallies. While developments in favor of a speculative improvement were of a favorable nature, the response was disappointing to the bull element in the market. The copper industry continues to show a remarkable degree of prosperity, and the condition of the iron and steel industry is indicated by the fact that the United States Steel Corporation has unfilled orders on hand for 7,600,000 tons. Increases are daily reported in the earnings of practically all the large railroad systems.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 6.

New York:	*Closing.*
Allis-Chalmers common	17⅞
Allis-Chalmers preferred	44⅜
Brooklyn Rapid Transit	77⅞
Consolidated Gas	138
General Electric	175½
Interborough-Metropolitan common	36¼
Interborough-Metropolitan preferred	75½
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	73½
Mackay Companies (Postal Telegraph and Cables) preferred	70½
Manhattan Elevated	145
Metropolitan Street Railway	104
New York & New Jersey Telephone	125
Western Union	86¾
Westinghouse Manufacturing Company	152¼

The annual meeting of the Manhattan Railway Company will be held November 14. Books close October 13, and reopen November 15.

Considerable interest has been manifested in General Electric stock, which, until Friday, October 5, sold around 166. From that point it advanced to 183⅞ on Monday, October 8. The rapid advance in stock gave rise to a number of reports. It is stated, however, that there is no foundation for a report of an increase in the dividend, and the only extraordinary benefit contemplated for stockholders in the immediate future consists of rights on the new stock which will be issued to stockholders at par. It is expected that these rights will be worth about $14 a share.

Boston:	*Closing.*
American Telephone and Telegraph	135
Edison Electric Illuminating	234
Massachusetts Electric	69½
New England Telephone	129
Western Telephone and Telegraph preferred	88

The directors of the American Telephone and Telegraph Company have declared a quarterly dividend of 2 per cent. The dividend is designated as quarterly, placing the stock upon a regular 8 per cent per annum basis, as against 7½ per cent heretofore. Following the declaration of the dividend, President Fish said: "It was the sentiment of the directors that in view of the earnings of the company and the outlook it seemed that this was the proper time to put into effect a policy that had been suggested for a long time, of putting dividends on a basis of 2 per cent quarterly with the expectation of continuing them at that rate." The dividend is payable October 15.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8¼
Philadelphia Rapid Transit	28⅞
United Gas Improvement	85¾

Chicago:	*Closing.*
Chicago Telephone	110
Chicago Edison Light	140
Metropolitan Elevated preferred	66
National Carbon common	84
National Carbon preferred	116
Union Traction common	5
Union Traction preferred	18

The September daily average of the Metropolitan Elevated was 126,975 passengers, an increase of 2,548.

The South Side Elevated daily average for September was 89,749, a decrease of 727 passengers daily.

Northwestern Elevated daily average of passengers carried for September was 77,508, an increase of 3,201.

Oak Park Elevated September daily average number of passengers, including transfers, was 44,742, a decrease of 1,109.

INDUSTRIAL ITEMS.

THE FRENCH BATTERY COMPANY, Madison, Wis., announces the appointment of A. J. Cox & Company, Stock Exchange Building, Chicago, Ill., as its general agent for Chicago. This company enjoys a wide acquaintance in the telephone field.

HARVEY HUBBELL, INCORPORATED, Bridgeport, Ct., has issued a catalogue and price list devoted to electrical specialties. In addition to the price list there are given illustrations of the apparatus and brief descriptive paragraphs, and there are also included a general index and an index to code words.

M. W. DUNTON & COMPANY, Providence, R. I., report an increased demand for their cotton tapes and sleevings, probably due to the unlooked-for rise in raw cotton. They have foreseen this result and have made arrangements whereby they are able to fill orders for their customers as promptly as usual.

THE ATLAS ENGINE WORKS, Indianapolis, Ind., has ready for distribution bulletin No. 132. This bulletin describes and illustrates medium-speed, automatic, four-valve engines. The literature has been carefully prepared and is supplemented by illustrations showing the detail and assembly of these machines.

THE BRISTOL COMPANY, Waterbury, Ct., announces the establishment of a branch office at 753 Monadnock Building, Chicago, Ill. This office will be able to fill rush orders, particularly for instrument supplies, and the representatives in charge will be pleased to offer helpful suggestions regarding the operation of Bristol recorders and supply full information concerning new types and the ranges of the various instruments.

A. W. CLAPP, 1164 Monadnock Block, Chicago, Ill., editor and publisher of "Hydroelectric Plants of the United States, Canada and Mexico," has just completed a trip through the New England states, and is about to make an extended trip through the South. Mr. Clapp is desirous of representing a few electrical supply houses during the coming winter in that section of the country.

THE DOWNWARD LIGHT ELECTRIC COMPANY, Union square East, New York, is marketing a type of incandescent lamp known as the "New Forty-Watt" lamp, which has the following guarantees endorsed by that company, *viz.:* seventy-one per cent more downward light than the standard form of incandescent lamps; 145 per cent longer life; twenty per cent less current consumption. By the standard type of lamp is meant the ordinary 3.1-watt, sixteen-candle-power lamp.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, announces the opening of a Chicago office in the Merchants' Loan and Trust Building, 135 Adams street, Chicago, Ill., with W. M. Connelly in charge. Mr. Connelly was connected with the electrical department of the Homestead works of the Carnegie Steel Company for five years, resigning his position there to become electrical engineer of the Ensley plant of the Tennessee Coal, Iron and Railroad Company, at Birmingham, Ala. After holding this position for three years he resigned to take up central-station work at Birmingham, Ala., and at Houston, Tex., where he organized and was in charge of the sales department. He enters upon his new duties fully equipped to take care of the interests of the Electric Controller and Supply Company in the Chicago district.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Ct.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 South Tenth street, Philadelphia.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty street, New York. Meetings, fourth Friday of each month.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnston, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West Thirty-first street, New York. Annual meeting, December 4-7, 1906.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall street, New York. Annual meeting, Columbus, Ohio, October 15-20, 1906.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, S. W. Mower, 12 Woodward avenue, Detroit, Mich. Annual meeting, Columbus, Ohio, October 15-19.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Ernest H. Davis, Williamsport, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Annual meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass. Annual meetings held in Boston on third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Ontario.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Ct. Annual meeting in November, 1906.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, George H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 1, 1906.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Rolland A. Davidson, 58 William street, New York city, N. Y.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot, 4 Irving place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.; assistant secretary, J. A. Harney, Electric Building, Cleveland, Ohio.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Iowa.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.
KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Lawrence, Kan., October 16-17, 1906.
KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.
MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.
MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.
MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.
MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, October 16, 1906.
MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F. Barnett.
NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.
NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.
NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y. Next meeting, New York city, 1907.
NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, 136 Liberty street, New York city.
NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION. Annual meeting, New York city, October 23-24.
NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State street, Boston, Mass.
NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty street, New York.
NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott square, Buffalo, N. Y.
NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.
OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.
OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.
OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, Ohio.
OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.
OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York.
ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.
PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.
PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia, Pa.
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.
PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.
RAILWAY SIGNAL ASSOCIATION. Secretary, H. S. Balliet, 337 Madison avenue, New York. Annual meeting, Washington, D. C., October 16, 17 and 18.
SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Secretary, T. H. Stuart, Waco, Tex.
STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. B. Fairchild, Jr., 114 Liberty street, New York.
UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.
VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.
VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electrical Light Company, Middlebury, Vt.
WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

DATES AHEAD.

American Society of Mechanical Engineers. New York, N. Y., December 4-7.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

National Machine Tool Builders' Association. New York city, October 23-24.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

Record of Electrical Patents.

Week of October 2.

832,072. REGULATOR FOR PRIME MOVERS. Lamar Lyndon, East Orange, N. J., Filed June 26, 1905. The prime mover drives an electric generator, the variations in speed of which actuate the controlling device through a relay.

832,084. RAILWAY SIGNALING SYSTEM. Benjamin F. Saurman, Philadelphia, Pa. Filed November 15, 1905. A visible signal on the train is operated by the semaphore.

832,121. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 23, 1902. Differential windings on the signaling device are unbalanced when calling, and balanced when talking.

832,135. COMBINED TELEPHONE RECEIVER AND MICROPHONE. Carl E. Ljungman, Robert O. P. Berglund and Walter A. W. E. Hjorth, Stockholm, Sweden. Filed February 14, 1906. The transmitter and the receiver are mounted in a single case divided into two compartments by a curved disc.

832,137. RAILWAY SWITCHING AND SIGNALING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. Makes use of a common return wire and indicating wires through which the current is shunted for actuating a signal.

832,138. RAILWAY SWITCHING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. Two wires are used, one for operating the apparatus and one for giving indications. Means are provided for making connection between the two.

832,139. RAILWAY SWITCHING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. A mechanically operated switch electrically controlled from a distance.

832,140. RAILWAY SWITCHING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. A method of operating a track switch by means of an electric motor.

832,147. REAR-LIGHT INDICATOR FOR AUTOMOBILES. Leo F. Murphy, Detroit, Mich. Filed September 5, 1905. The light is controlled by a thermostat.

832,153. ELECTRIC SIGNALING APPARATUS. Chas. J. O'Neil, Washington, D. C. Filed February 4, 1905. Distinctive signals may be set by various positions of one controller.

832,165. RAILWAY SWITCH OPERATING AND CONTROLLING APPARATUS. Wilmer W. Salmon, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company, Buffalo, N. Y. Filed July 15, 1901. Renewed May 17, 1906. The operating motor has two independent field-windings controlled by a polarized relay.

832,166. RAILWAY SWITCHING AND SIGNALING APPARATUS. Wilmer W. Salmon and Frank L. Dodgson, Buffalo, N. Y., assignors to General Railway Signal Company, Buffalo, N. Y. Filed January 6, 1906. A magnetic switch-lock controlled from a distance.

832,174. RAILWAY SIGNALING APPARATUS. John D. Taylor, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company, Buffalo, N. Y. Filed January 22, 1904. The signal blade and counterweight are mounted on separate rods, which may be controlled independently or coupled together.

832,175. RAILWAY SWITCHING APPARATUS. John D. Taylor, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company, Buffalo, N. Y. Filed January 22, 1904. Renewed February 3, 1906. Makes use of an electromagnetic indication-selector.

832,181. ELECTROMAGNETIC DEVICE. William W. Dean, Chi-

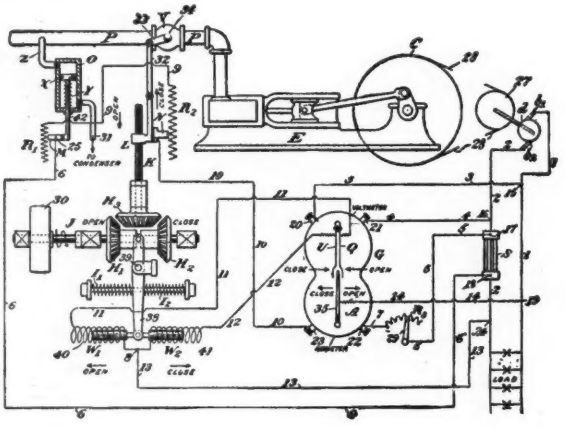
cago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed June 19, 1903. A method of mounting electromagnetic coils such as are used on telephone switchboards.

832,185. RIGHT-ANGLE ADJUSTABLE CROSSING FOR ELECTRIC RAILWAYS. Edward E. Gilmore, Philadelphia, Pa. Filed September 27, 1905. A pivoted adjustable trolley crossing.

832,192. RAILWAY SWITCHING AND SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y. Filed August 29, 1905. Reciprocating motion is secured by means of a cam plate shifted by a motor.

832,193. RAILWAY SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed November 27, 1905. The signals are controlled by a hand-controlled generator.

832,194. RAILWAY SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y. Filed May 17, 1906. The operating motor has two field-windings for controlling the direction of rotation.



832,072. Regulator for Prime Movers.

832,195. RAILWAY SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company, Buffalo, N. Y. Filed July 20, 1903. Renewed May 17, 1906. The actuating motor is mounted vertically and drives through an anti-friction screw.

832,280. REFLECTOR SHADE. William H. Spencer, Brooklyn, N. Y., assignor to George Frink Spencer, Newark, N. J. Filed May 2, 1905. A method of constructing a reflector suitable for incandescent lamp clusters.

832,297. SAFETY DEVICE FOR ELECTRIC SIGNALS. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed June 16, 1904. The signaling device is operated by passing trains.

832,302. METHOD OF SEALING METAL INTO GLASS OR OTHER VITREOUS MATERIAL. Carl A. Ernst, Schenectady, N. Y., assignor to General Electric Company. Filed June 12, 1903. The wire, freed from occluded gases, is provided with a glass coating.

832,312. SECTION-INSULATOR FOR ELECTRIC RAILWAYS. Edward E. Gilmore, Philadelphia, Pa. Filed September 27, 1905. Renewable wear-shoes are provided.

832,314. COIN-CONTROLLED MECHANISM. Rudolph W. Goeb, St. Louis, Mo., assignor to The Controller Company of America, St. Louis, Mo. Filed February 13, 1903. Locking and delivering mechanisms are electrically controlled.

832,353. COMMUTATOR. Roger S. White, Philadelphia, Pa., assignor to General Electric Company. Filed October 14, 1902. Concentric rollers are employed for collecting the current, placed so that jarring is prevented.

832,354 MAGNETO-ELECTRIC GENERATOR. Joseph A. Williams, Cleveland, Ohio. Filed May 14, 1906. A method of mounting a magneto.

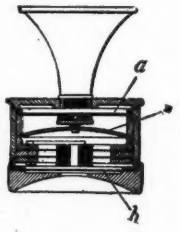
832,357. SYSTEM OF ELECTRICAL DISTRIBUTION. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company. Filed April 25, 1900. Means are provided for operating the speed of a generator connected in series with one of the mains, thus controlling the load on the system.

832,363. VAPOR-TUBE STARTING DEVICE. Theodore Bodde, New York, N. Y., assignor to Louis B. Marks, New York, N. Y. Filed March 16, 1904. Employs a stationary auxiliary terminal in contact with one electrode before starting, but automatically disconnected after starting.

832,402. TIME SWITCH. Peter Mattern, Cleveland, Ohio. Filed August 9, 1905. Renewed May 12, 1906. The actuating weight is released by a clock.

832,416. ELECTRIC RAILWAY. Leon W. Pullen, Camden, N. J. Filed May 18, 1905. An electromagnetic surface-contact system.

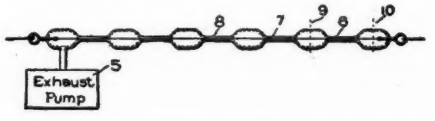
832,425. INTERCOMMUNICATING TELEPHONE. Lambert Schmidt, Weehawken, N. J. Filed September 16, 1905. A name-plate and pointer are provided for indicating the proper connection.



832,135. Combined Telephone Receiver and Microphone.

832,443. TELEPHONE SYSTEM. Paul Arnheim, Hamburg, Germany, assignor to the firm of Telephon-Fabrik Actiengesellschaft, vorm. J. Berliner, Hanover, Germany. Filed June 25, 1902. A selective automatically locking-out party-line system.

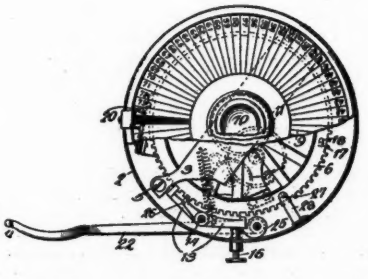
832,462. AUTOMATIC ELECTRIC BRAKE. Augustus L. Duwelius, Cincinnati, Ohio. Filed May 7, 1904. The brake is controlled by a generator driven from the car axle.



832,302. Method of Sealing Metal into Glass or Other Vitreous Material.

832,544. AUTOMATIC TROLLEY GUARD. John R. French, Los Angeles, Cal. Filed November 15, 1905. A trolley-wheel fender automatically brought into position when the wheel leaves the wire.

832,548. SYSTEM OF RAILWAY SIGNALING. Harry L. Johnson, Topeka, Kan. Filed April 29, 1905. An automatic block-signal system.



832,562. Telephone Call-Box.

832,562. TELEPHONE CALL-BOX. Anthony Van Wagenen, Sioux City, Iowa. Filed July 30, 1903. Renewed March 3, 1906. Makes use of a rotatable contact-maker.

832,568. ELECTRIC TIME SWITCH. William S. Andrews, Schenectady, N. Y., assignor to General Electric Company. Filed December 15, 1903. The switch is operated by a clock mechanism.

832,577. TIME-LIMIT CIRCUIT-BREAKER. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed February 11, 1899. Renewed October 18, 1901. A polyphase circuit-breaker, the opening of which is retarded by a clock mechanism.